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DEPARTMENTS OF VETERANS AFFAIRS AND HOUSING AND URBAN DEVELOPMENT, AND INDEPENDENT AGENCIES APPROPRIATIONS FOR 1995

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Departments of Veterans Affairs and...

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BEFORE A

SUBCOMMITTEE OF THE

COMMITTEE ON APPROPRIATIONS
HOUSE OF REPRESENTATIVES

ONE HUNDRED THIRD CONGRESS

SECOND SESSION

SUBCOMMITTEE ON VA, HUD, AND INDEPENDENT AGENCIES

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PART 2

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National Science Foundation 1
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DEPARTMENTS OF VETERANS AFFAIRS AND HOUSING AND URBAN DEVELOPMENT, AND INDEPENDENT AGENCIES APPROPRIATIONS FOR 1995

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DEPARTMENTS OF VETERANS AFFAIRS AND HOUSING AND URBAN DEVELOPMENT, AND INDEPENDENT AGENCIES APPROPRIATIONS FOR 1995

Tuesday, March 22, 1994.

NATIONAL SCIENCE FOUNDATION

WITNESSES

NEAL LANE, PH.D., DIRECTOR
JAMES J. DUDERSTADT, PH.D., CHAIRMAN, NATIONAL SCIENCE BOARD
FREDERICK M. BERNTHAL, PH.D., DEPUTY DIRECTOR
JOSEPH KULL, CHIEF FINANCIAL OFFICER AND DIRECTOR, OFFICE OF BUDGET, FINANCE AND AWARD MANAGEMENT
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LINDA SUNDRO, INSPECTOR GENERAL

Opening Remarks

Mr. Stokes. The committee will come to order. The National Science Foundation is requesting a total of $3,200,000,000 for fiscal year 1995. This request is $182,200,000, or 6 percent, above the fiscal year 1994 level.

Today we will be hearing from Dr. Neal Lane, the new Director of the National Science Foundation, and Dr. James Duderstadt, Chairman of the National Science Board. We welcome both of you.

Dr. Lane, this is your first appearance before our subcommittee, and we are delighted to have you here.

I appreciate the visit that you made to my office as a courtesy, and I would like to have you introduce your associates at the table, and then you may proceed with your opening statement or recognize Dr. Duderstadt first. Whichever way you would like to proceed will be fine with the subcommittee.

Dr. LANE. Thank you, Mr. Chairman. We appreciate the opportunity to be here today to talk about the 1995 fiscal year budget for the NSF. I would like to introduce my associates now who are in the room. Dr. Fred Bernthal, who is Deputy Director; Mr. Joe Kull, Chief Financial Officer; Dr. Mary Clutter, Assistant Director for Biological Sciences.

I assume people are raising fingers, right? Thank you. Dr. Joe Bordogna, Assistant Director for Engineering; Dr. Mel Ciment, Assistant Director for Computer and Information Science and Engineering; Dr. Luther Williams, Assistant Director for Education and Human Resources; Dr. Robert Corell, Assistant Director for Geosciences; Dr. Neal Sullivan, Director of the Office of Polar Programs; Dr. Bill Harris, Assistant Director for Mathematical and Physical Sciences; Dr. Cora Marrett, Assistant Director for Social, Behavioral and Economic Sciences; Dr. Nathaniel Pitts, Director, Office of Science and Technology Infrastructure; Dr. Gene Cota–Robles, Equal Opportunity Advisor to the Director; Ms. Constance McLindon, Director of the Office of Information and Resource Management; Mr. Larry Rudolph, Acting General Counsel; Ms. Linda Sundro, Inspector General; and Dr. Ray Bye, Director of Office of Legislative and Public Affairs.

Mr. STOKES. Thank you. We welcome all of you.

Dr. LANE. Thank you. I am also accompanied by Dr. James Duderstadt, who is Chairman of the National Science Board and President of the University of Michigan, and with your permission I would like to have Dr. Duderstadt offer a statement for the record on behalf of the National Science Board, and I request he be given a few moments to summarize his statement.

STATEMENT BY DR. DUDERSTADT

Mr. STOKES. Dr. Duderstadt, we are pleased to have you with us this morning. We will put your entire statement in the record at this point and you may proceed in any way you would like.

Dr. DUDERSTADT. Thank you very much, Mr. Stokes. It is an honor to be able to make some comments in support of the budget recommendation for the National Science Foundation, and also to express the deep gratitude on the part of the National Science Board for the very strong support this committee has provided the Foundation in its activities.

We are obviously in these days in the midst of enormous change in our world, and they are changes that are driven by a society which is becoming increasingly dependent upon educated people and their ideas as, literally, the wealth of nations.

The National Science Foundation, of course, plays a tremendously important role in producing both basic scientific research and the educated people capable of applying this knowledge. Throughout the history of this nation, scientific research has had great impact in responding to national needs: Development of modern agriculture, responding to the needs of national defense, health care, and as our Nation shifts toward new priorities and new needs, whether it be economic competitiveness, rebuilding the national infrastructure, and so forth, we believe the National Science Foundation will continue to play a vital role.

Several months ago the President of the National Academy of Sciences gave a short list of the products which flowed out of these intellectual activities, and I would like to just mention some of these activities, because they are quite interesting: Modern agricultural products, biotechnology, magnetic resonance imaging, penicillin, modern machine tools, digital signal processing, modern computers, lasers, computer workstations, artificial intelligence, word processing, instrument landing systems, inertial guidance. All of these at one point or another flowed out of very fundamental research, much of it conducted in the Nation's research universities and most of it supported by the Federal Government. So those ideas are absolutely critical in addressing the needs of our society.

Beyond that, the National Science Foundation plays a very critical role in producing science and engineering human resources, so necessary for the Nation, whether it is at the advanced level, the Ph.D., or whether it is K–12 education, or whether it is due to general societal awareness of the importance of science. And so, in a sense, we believe that the Foundation really will play a pivotal role in this Nation's effort to respond to the challenges of the world that is rapidly changing about us.

For that reason, the Board strongly supports the President's proposed budget for the National Science Foundation, and we look forward to working with Congress to strengthen all aspects of Federal investment in science and technology and in education.

[The information follows:]

Testimony of Dr. James J. Duderstadt
Chairperson, National Science Board
Before the
House Appropriations Subcommittee on
Veterans Affairs, Housing and Urban Development and
Independent Agencies
March 22, 1994

As Chairperson of the National Science Board, it is an honor and privilege to have this opportunity to testify in support of President Clinton's proposed budget for the National Science Foundation. The six percent increase that the President has provided to the National Science Foundation represents a critical investment that will enhance our Nation's capabilities in science, engineering and education.

The vitality of NSF's mission and the importance of research and education in advancing the national interest was recently affirmed by the report of the Board's special Commission on the Future of the National Science Foundation. Research, as noted in the Commission's report and supported by NSF, functions both to achieve broad national strategic goals and to increase the base of knowledge for future science and technology needs. In addition, exposure of our youth to the problem solving approach inherent in the conduct of research helps prepare them for a lifetime of work experiences.

The National Science Board is seeking to focus national attention on major issues of science and engineering research and education. Last month, following an extensive review of the most current data available, the Board highlighted three critical issues that we feel must be addressed if this Nation is to maintain its leadership in science and technology and assure the productivity of its research and education systems. I have attached the NSB's statement, "Toward the Next Century: The State of U.S. Science and Engineering," NSB 94-24, February, 1994, to my written statement.

First, the production and use of knowledge requires a commitment to strong and consistent long-term Federal investments in the science, engineering, and education enterprise. We have only to look around us to see the benefits of the past half century of broad-based Federal support -- benefits so ingrained in our daily lives that we often take them for granted. The health of the U.S. economy and the competitiveness of our industries rely increasingly on the exploitation of scientific and engineering advances and on the availability of an adaptable, educated and technologically prepared workforce.

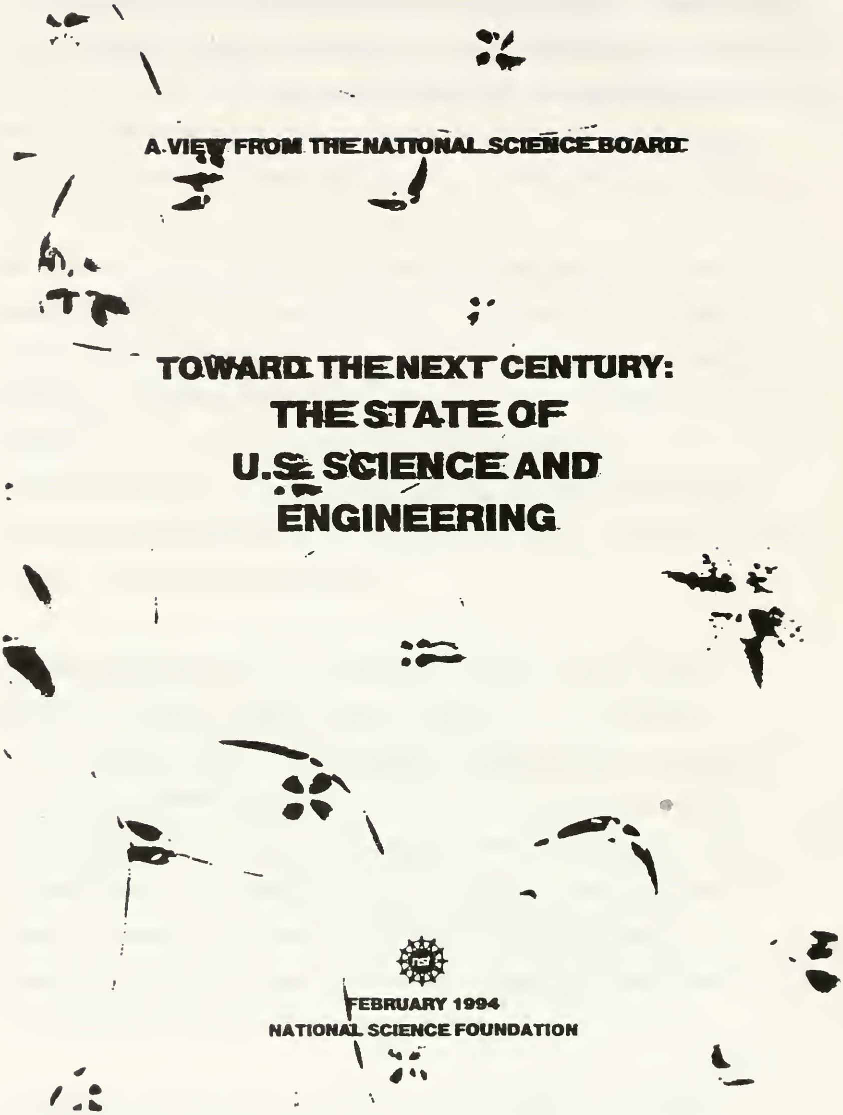
The current Federal R&D budget reflects a continuing adjustment to post-Cold War priorities and a renewed focus on civilian needs. Despite the increasing importance of civilian research for innovation and economic growth however, we as a Nation continue to lag behind some of our international competitors in the percentage of gross domestic product devoted to nondefense R&D. Colleges and universities, in concert with industry, and state and local governments, have helped pick up the slack by increasing their share of total R&D funding. But it is also clear that the pursuit of new knowledge and its transformation to societal benefits has become increasingly costly as we address more complex problems that require ever more powerful instruments and analytic techniques.

The NSF budget will support a diverse portfolio of activities, some of which directly contribute to the achievement of current strategic national goals, and some of which hold potential for addressing future societal needs that we cannot forsee today. Federal R&D support is appropriately viewed as an investment in the Nation's future. All investments come with a degree of risk. Not all investments will pan out, but those that do can provide a tremendous return and shape the course of our society and the quality of life for you, for me, and for our children.

The second critical issue raised by the Board is the Nation's need for a technically competent and scientifically literate workforce. The general public recognizes the value of continued investment in science and technology and the importance of education for achieving personal and national goals. At the same time, however, the general level of scientific literacy and technical preparedness is not adequate to meet the emerging needs of our changing economy. Consequently, precollege science and mathematics education is a major national concern being addressed by a variety of NSF programs in the budget.

Third, the continuing need to encourage innovation and to ensure the most effective use of scarce resources demands a stronger focus on cooperative activities, both domestically and internationally. Collaborations not only achieve cost savings to American taxpayers through shared funding and use of facilities and other resources, but people working together across traditional disciplinary boundaries generates new knowledge and excitement among the participants. New university partnerships with industry for example will result in more effective diffusion of knowledge and ideas from academic settings to industrial applications. The budget before you promotes these partnerships.

The National Science Board is committed to maintaining U.S. leadership in science and technology and assuring the productivity of our research and education systems. The Board strongly supports the President's proposed budget for NSF, and we look forward to working with the Congress to strengthen all aspects of the Federal investment in science, technology and education.



A VIEW FROM THE NATIONAL SCIENCE BOARD

TOWARD THE NEXT CENTURY: THE STATE OF U.S. SCIENCE AND ENGINEERING

FEBRUARY 1994
NATIONAL SCIENCE FOUNDATION

I. Introduction

The National Science Board (NSB) is charged with focusing national attention on major issues of science and engineering research and education. An important aspect of this responsibility is the publication of *Science & Engineering Indicators*, a biennial report of data and trends on American research and education in the sciences, mathematics, and engineering. This report, submitted to Congress through the President, provides a quantitative overview of the health and achievements of the science and technology enterprise. To accompany *Science & Engineering Indicators - 1993*, the Board presents this statement highlighting issues that must be addressed by the Nation to maintain continued U.S. leadership in science and technology and to assure the productivity of our research and education systems.

II. The Changing Context for American Science and Engineering

> *"Investing in science and technology is investing in America's future."* [1]
>
> William J. Clinton
> November 23, 1993

The 11th issue of *Science & Engineering Indicators* appears at a crucial time. As the 20th century draws to a close, the world is reaping the benefits of a half-century of broad-based Federal investment in science and technology. The knowledge produced by scientists, mathematicians, and engineers has dramatically increased agricultural production; it has created new industries such as semiconductor manufacturing and biotechnology; it has connected the world with information networks; and it has created the means for a dramatically healthier and longer lifespan.

Science and technology will be even more important in the next century. With the end of the Cold War and the rise of a global economy, national and international goals for science and technology are being shaped by new forces of economic interdependence and competition. The knowledge produced by scientists, mathematicians, and engineers must be utilized to foster sustainable development in all nations and to contribute to the solution of global problems.

Within the new international context, the health of the U. S. economy and the competitiveness of our industries rely increasingly on the exploitation of scientific and technological advances and on the availability of an adaptable, educated, and technically prepared workforce. The growing internationalization of science and significant improvements in human resources and research capabilities of other nations require that the United States maintain and enhance its own capabilities to take advantage of discoveries around the globe.

The next few years will be critical for establishing the policy directions that will guide us in the new era. In the transition to a new political and economic framework, it is vital that the United States maintain the momentum generated by decades of sustained growth and commitment to excellence in science and engineering. The ability to do good science, and to do good with it, are not guaranteed. Both will require investment in all components of the system—industrial research and development (R&D), national laboratories, and academic institutions—as well as in areas of strategic importance requiring special attention.

III. Trends

Investment in Science and Engineering

The United States still leads the world in total national and industrial R&D investment[2] and continues to set the standard for excellence in research and higher education. At the same time, there are concerns about U.S. performance in the global context.[3]

Other countries are closing the gap with—or are even leading—the United States by some measures.[4] Newly industrialized countries have sharply increased their investment in science and engineering. As one result, in 1991 the combined natural science and engineering baccalaureates of six Asian nations exceeded those of North America and Europe taken together.[5]

Total national R&D expenditures, adjusted for inflation, rose rapidly from the mid-seventies through the first half of the eighties. However, since 1985 they have been virtually flat.[6] Furthermore, as noted by the recent NSB report, *The Competitive Strength of U.S. Industrial Science and Technology*, "... the real rate of growth in U.S. industrial R&D spending has declined since the late 1970s and early 1980s."[7]

The photomicrograph on the cover depicts crystallites of the common vitamin *Biotin (Vitamin H).*

The current Federal R&D budget reflects continuing adjustment to post-Cold War priorities and renewed focus on civilian needs. In particular, over the last decade defense spending has declined from 69 to 59 percent of the Federal R&D budget.[8] Nevertheless, despite the increasing importance of civilian research to innovation and economic growth, we continue to lag behind some other industrialized nations in the percentage of the gross domestic product devoted to nondefense R&D.[9]

Colleges and universities continue to increase their share of national R&D.[10] But Federal funding as a proportion of the total support for university research has declined since 1980, while the contributions from industry, state and local government, and universities have increased. Also, in spite of greatly increased university investment in research facilities and instrumentation, a substantial proportion of academic research space is in critical need of renovation and repair, and research instrumentation needs have grown.[11]

Human Resources and the Workforce

The public attitude regarding both the value of continued investment in science and technology and the importance of education to achieving personal and national goals remains strongly positive.[12] At the same time, the American public's level of scientific literacy and general technical preparedness are not adequate to meet the needs of the changing economy.[13] A productive, adaptable, and skilled technical workforce for all sectors of the economy depends on the quality of the Nation's education system at all levels. Consequently, the state of education in science and mathematics at the precollege level remains a major national concern. In international comparisons, the United States continues to lag behind the highest achieving nations, even when comparing our best school districts with their national performance.[14]

The U.S. system of higher education is facing new pressures and financial constraints. Enrollments in institutions of higher education continue to rise, and the student body has become increasingly diverse with respect to age, ethnicity, and walk of life. At the same time, the absolute number of undergraduate degrees awarded in engineering, mathematics, and computer sciences continued to decline in 1991. However, the increase in full-time undergraduate engineering enrollments from 1990 through 1992, after a 9-year decline, portends a rise in degrees in the coming years. While women and African American, Hispanic American, and Native American minorities have increased their representation in science and engineering disciplines, their participation rates remain unacceptably low.[15]

Two-year institutions have absorbed most of the increase in college enrollments in recent years. But associate degrees in engineering technology, mathematics, computer sciences, and engineering have fallen since the mid-1980s.[16] Declining interest in these degrees in 2-year colleges has special significance for efforts to increase participation by groups traditionally underrepresented in technical disciplines—groups that form a disproportionate share of the enrollment of 2-year institutions.

Job opportunities and salaries for recipients of science, mathematics, and engineering degrees remain better than for other disciplines.[17] But there has been a decline in overall science and engineering employment rates. In some fields, high proportions of new Ph.D. recipients are taking post-doctoral positions, and part-time employment is becoming more common at universities and colleges. Some professional associations also report extended time for job searching for Ph.D. graduates.[18] A much more pessimistic outlook pervades defense-related industries. In engineering occupations, downsizing among some industries and reduction in defense spending have contributed to a doubling of the unemployment rate from 1987 to 1992.[19]

Partnerships and Institutional Concerns

Partnerships and cooperative arrangements in science, mathematics, and engineering research and education are becoming more important and prevalent both domestically and internationally. The excitement and importance of multidisciplinary research, the cost savings achieved through shared facilities and resources, the more rapid diffusion of knowledge, and the explosion of information networks—all these factors have provided powerful incentives for the increase in collaborative approaches.

In the United States, cooperation in R&D activities within and among sectors increased rapidly over the last two decades. Activities such as university-industry research centers, multi-firm R&D alliances, and coauthorship of scientific articles have increased.[20] States have become important players in promoting cooperation at the local level.[21]

For the Federal Government, the continuing need to encourage innovation and to ensure the most effective use of scarce financial resources has resulted in a stronger focus on cooperative activities. The reorganization and downsizing of defense-related activities underscore the urgency for national laboratories to cooperate with the private sector in defining new missions with benefits to civilian needs.[22]

IV. Issues and Actions

> *"Science, by itself, provides no panacea for individual, social, and economic ills. It is effective in assuring the national welfare . . . as a member of a team . . . [But] without scientific progress, no amount of achievement in other directions can insure our health, prosperity, and security as a nation in the modern world."* [23]
>
> Vannevar Bush, 1945

Investment in Science and Technology

A robust knowledge base appropriate for economic growth, long-term job creation, protection of the environment, and social well-being requires a conscious commitment to strong and consistent long-term support for research and education as a part of a balanced portfolio of activities and investments. A coherent national science and technology policy, a stronger industrial research effort, and a refocused mission for Federal laboratories are essential components of this commitment. Equally critical, as stated in the May 13, 1993, NSB white paper, *In Support of Basic Research*,[24] is a strong foundation of basic research.

The process of research in fundamental sciences and engineering expands the knowledge base and directly contributes to strategic national goals through pioneering discoveries and the continued development of a cadre of educated people who are the source of new solutions and new opportunities. Apart from its contributions to specific areas of national importance, the overriding strategic value of basic research resides in going beyond research areas and questions whose utility is understood to those whose applications have yet to be discovered. As noted by industry leaders in a recent report, the primary value of the university is in basic research and education. These activities require and deserve stable Federal support.[25]

Recommendations:

- *An increased fraction of savings resulting from cuts in defense R&D spending should be redirected to dual-use technologies and support of civilian research priorities in strategically important areas.*
- *A national initiative should be established for the renovation and modernization of university research facilities and major capital equipment.*

A Technically Prepared Workforce, A Scientifically Literate Public

A technically competent and scientifically literate workforce drawing on a diverse and talented population is essential to this Nation's future. Changing labor market conditions for scientists and engineers—and the broad-based requirement for a more technically trained, qualified, adaptable workforce and citizenry—require continued national leadership to ensure quality education at all levels. Increasingly important in this context is the coordination of the educational process with the present and future needs of the marketplace.

Recommendations:

- *Mathematics, science, and engineering curricula at all levels of education should be evaluated to ensure that all students obtain the background needed for the workforce of the future. Appropriate education should be responsive to workforce needs and opportunities in industry and government as well as universities.*
- *Federal agencies must increase their cooperation with state governments, educational institutions, and other groups in systemic educational reforms, such as those promoted by the National Science Foundation, to improve the quality of precollege education in the sciences, mathematics, and engineering.*
- *Building on successful models, Federal and state governments must redouble their efforts to increase the participation of women and underrepresented minorities. At the post-secondary level, special attention should be given to 2-year institutions, which have absorbed the great bulk of growth in enrollments and serve a highly diverse population.*

New Partnerships and Institutional Issues

The coming century will impose greater demands and responsibilities on all who have a stake in the discovery and use of knowledge. A more rapid pace of discovery, the increasing importance of multidisciplinary research, and the confluence of research interests and opportunities across institutional lines call for industry, academia, and government to supplement traditional modes of research support with creative approaches and relationships, both domestically and internationally.

Innovative institutional arrangements appropriate to the needs of complex multidisciplinary research teams have been the focus of many new government programs. These new approaches, complementing the work of individual investigators, must continue to be tested and successful models expanded. New university partnerships with industry respond to pressures for greater relevance to societal needs in research and education, and for more effective diffusion of knowledge and ideas from academic research to industrial applications. They also offer special opportunities to explore new research directions.

At the same time, the growing number of collaborative arrangements often results in more complex issues concerning conflicts of interests and individual property rights. Regional economic development initiatives, incorporating collaborative research arrangements between industry and academia, will call on states to assume a stronger, catalytic role.

Recommendations:

- *Federal agencies that provide substantial support for science and technology must pursue international cooperation more systematically in science, mathematics, and engineering research to expand the global knowledge base, increase diffusion of knowledge generated abroad to U.S. scientists and engineers, and share the opportunities of global research initiatives and expenses of operating costly research facilities and capital equipment.*
- *Clear guidelines are needed with respect to conflicts of interests and intellectual property issues as they apply to academic research.*
- *Federal and state governments must develop more coherent and supportive relationships with academic institutions to encourage a greater use of knowledge generated by academic research*

A New Context for Science and Technology Policy

The new global environment and constraints on the Federal budget demand a fresh and vigorous national vision for public support of science and technology and better organizational and policy coordination within both the Executive Branch and Congress. Examples of important new approaches to rationalize Federal missions and processes in science and technology include the new National Science and Technology Council, chaired by the President, and its Fundamental Science Research Committee.

There is also a universally recognized need for greater accountability in the planning and implementation of all government missions, including support for research and education. Important Administration efforts to increase the efficient use of resources call on agencies to emphasize: self-assessment; improved performance of their missions; close attention to priority setting and planning; and support for flexible, cooperative arrangements that take advantage of good ideas wherever they are found. New cross-agency initiatives, such as the Technology Reinvestment Project, that focus on the development of technologies serving both civilian and defense-related needs suggest productive models for leveraging limited research dollars.[23]

Recommendations:

- *All agencies should systematically assess their contributions to the Nation's R&D capacity, both by evaluating their own programs and increasing coordination with other agencies in areas of mutual interest.*
- *The science and engineering communities need to communicate to Federal sponsors and the public the linkage of their activities with national goals.*
- *Federal advisory and deliberative structures for science and technology should more systematically seek the input of private industry and other stakeholders.*

V. Conclusion

American science and technology are challenged by extraordinary opportunities to expand the knowledge-based horizons of humankind. Shaping a new national strategy for science and technology and the means to implement it and evaluate its success is the major task confronting Federal science and technology policy today.

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1. William Jefferson Clinton, "Statement of the President" (Washington, D.C.: White House Office of Media Affairs, November 23, 1993).

2. National Science Board, *Science & Engineering Indicators - 1993*, NSB 93-1 (Washington, D.C.: Government Printing Office, 1993) p. xvii.

3. Ibid., pp. xvi, xviii.

4. Ibid., p. xvi.

5. Ibid., p. xvii.

6. Ibid., p. 91.

7. National Science Board, *The Competitive Strength of U.S. Industrial Science and Technology: Strategic Issues*, NSB-92-138 (Washington, D.C., National Science Foundation, 1992), pp. ii.

8. *Science & Engineering Indicators - 1993*, p. xxi.

STATEMENT BY DR. LANE

Mr. STOKES. Thank you very much, Dr. Duderstadt. We appreciate your opening statement.

Dr. Lane, we are back to you.

Dr. LANE. Thank you, Mr. Chairman. I would also like to thank you and the committee for your strong support of the National Science Foundation and specifically for the 11 percent increase contained in the 1994 appropriation. Very appreciative of that chance to begin my term as director under such positive circumstances.

In my testimony this morning, I would like to give a brief overview of the NSF budget request and follow this with a highlight, a couple of highlights of some recent work supported by the National Science Foundation. We are requesting $3.2 billion for fiscal year 1995. This is a 6 percent increase or an additional $182 million over last year. I recognize that the current budget climate means that few agencies will be given increases in their budgets in the coming year.

Our request reflects an approach to planning that places increased emphasis on research and education that is consistent with the national priorities. The President's priorities are for investing in research that will allow the United States to maintain world leadership in basic science, mathematics and engineering, while at the same time providing the basis for long-term economic growth which protects the environment.

Of the incremental funds available to NSF, more than 75 percent will go to research and education in the following strategic areas: global change research; high performance computing and communication; advanced manufacturing technology; advanced materials and processing; environmental research; biotechnology; civil infrastructure systems; and science, mathematics, engineering and technology education.

I would like to stress that the funding increases in these priority areas have implications for many programs. Much of the work supported in our agile manufacturing program, for example, is possible only because it is closely associated with work funded in high performance computing and communications. This synthesis of new discoveries from different research areas makes for very exciting programs, and we have to look beyond the budget numbers to appreciate the rich connections that exist between these programs.

At the same time, we must continue to nurture research that does not appear to be immediately relevant to specific goals, at least goals that we can see at this point in time. These opportunities hold potential for future applications, very important to the lives of the people, and it is this ordinary science that provides the steady accumulation of information that makes eventual breakthroughs possible.

Let me offer a few recent examples of some of the particularly exciting work that is supported by the NSF. Last October, Business Week Magazine reported on NSF-funded research on bacteria that can digest oil, a potentially significant factor in cleaning up oil spills. Unfortunately, when these bacteria ingest oil, they become heavy and sink below the surface where they can no longer dissolve the oil.

NSF-funded researchers have reported successful efforts to modify the genes of these bacteria to give them flotation chambers that allow them to remain on the surface where they can continue to digest the oil. By supporting basic research in the area of biotechnology, NSF is helping provide information that businesses can use to develop products and processes with worldwide markets.

Biotechnology is already a $4 billion a year industry, and by the end of the decade is expected to account for $15 billion in sales by U.S. companies.

Another example of a near-term payoff from NSF support is in our Alliances for Minority Participation Program, the AMP Program, which is making great strides in boosting the science, engineering and mathematics enrollment of underrepresented minorities.

When we began the AMP program in 1991, underrepresented minorities accounted for about 14,000 baccalaureate degrees in science, engineering and mathematics annually. Our 15-AMP consortia, the oldest of which has been in operation just over two years, have already produced a net increase of 1,500 baccalaureate degrees to minorities. These examples show how leading-edge research and education can contribute immediately to addressing real world concerns.

Progress doesn't mean changing the quality of research we support, but changing how we think about it, organize and evaluate what we do. We have begun to pay closer attention to assessing how the research we support is disseminated and used. By organizing our activities in ways that emphasize relevance to national priorities, we hope to foster stronger connections between the academic community, industry and public policy. Still, much of what we fund has uncertain implications. Much is intended to fill gaps in the knowledge or provide a means for future exploration.

Let me give you some examples of how we are approaching the issue of evaluating our progress. Over the past 20 years, we successfully developed models for linking academic researchers with their counterparts at various centers. One measure of success at NSF-supported centers is the willingness of industry to fund center-based research.

In our engineering research centers, contributions from other sources represent about two-and-a-half times the NSF contribution. In our State-Industry-University cooperative research centers, 168 companies contribute $10 million annually, three times the NSF share, and work with over 600 faculty and students on research relevant to the regional economy.

At our industry-university cooperative research centers, NSF's contribution is leveraged 15-fold when all sources of support—industry, universities and States—are considered. We also recognize the need to provide a stronger evaluation component for our educational activities.

As you know, we formed partnerships with 25 States and Puerto Rico through our statewide systemic initiatives, to develop comprehensive changes in their educational systems. The approach has been extended with the urban systemic initiatives, focusing on cities with large numbers of at-risk youth, and the rural systemic initiatives which address the special needs of economically disadvantaged rural regions. Each of those systemic reform activities has an evaluation component that is an integral part of the proposed initiative.

I am committed to expanding efforts to evaluate NSF programs, both those that reflect strategic areas and those directed toward the discovery of knowledge. This is critical to ensuring that our programs accomplish what they intend and continually renew the public trust in what we do.

Let me conclude by briefly discussing our request for funds to repair, renovate and modernize academic research facilities and instrumentation. The cost to renovate and upgrade academic research facilities has been estimated at around $10 billion. We are providing little more than nominal assistance for the infrastructure. To do more within this requested level would seriously skew NSF's highest priority, putting creative people and their ideas first.

In September, NSF's next biennial report on the academic research infrastructure will be available to provide an up-to-date assessment of the needs. I have talked with Dr. John Gibbons, Director of the Office of Science Technology and Policy, about this issue and the need to give academic infrastructure priority consideration within the National Science and Technology Council.

Our budget request for this activity is the same as it was last year and will allow us to continue upgrading facilities while we work to develop a more inclusive approach.

In conclusion, Mr. Chairman, our budget request for the coming fiscal year emphasizes support for the highest quality research, and in closing, I would like to emphasize that our budget request represents a carefully considered set of research and educational priorities.

Our budget connects work across strategic areas in order that each can build on the work of the others in making progress to our national goals. It represents an integrated plan that is much more than the collection of individual research and education activities within it.

I look forward to working with you, Mr. Chairman, and your committee, to make NSF's contribution, to the Nation even more significant in the future than they have been in the past. I thank you and would be very pleased to respond to any questions you might have.

[The information follows:]

Testimony of Dr. Neal F. Lane
Director, National Science Foundation
Before the
House Appropriations Subcommittee on
Veterans Affairs, Housing and Urban Development, and
Independent Agencies
March 22, 1994

Thank you for the opportunity to testify today on the 1995 fiscal year budget request for the National Science Foundation. I am accompanied by Dr. James J. Duderstadt, Chairman of the National Science Board, who has submitted testimony and a statement from the Board that emphasizes the important role of basic research in the health of our economy. I agree with this view, and it is a view that is reflected in the President's budget request that we will discuss this morning.

Since my appointment as Director of NSF, I have had a chance to discuss the future of NSF with you and I have also had a number of occasions to talk with various groups in the research community about how NSF can best contribute to the nation's well being. Based on these discussions, I believe that this budget request represents a very positive statement on the value of scientific and engineering research and education to the nation's well-being.

Before getting into the specifics of our budget request, I would be remiss if I failed to express our deep appreciation to you and your Committee for the generous 11 percent increase you provided for NSF in the 1994 appropriation. It arrived at NSF at about the same time that I did. So even though I can't take credit for it, I am very appreciative of the chance to begin my term as Director under such positive circumstances.

In my testimony this morning I would like to begin with a brief overview of the National Science Foundation budget request and follow this with a summary of some of our major programs. I will then provide highlights of recent work supported by NSF and conclude with a look at some issues that I think must be considered in the coming months at NSF.

Our request for Fiscal Year 1995 is for $3.2 billion. This is a 6 percent increase, or an additional $182.2 million over last year. I recognize that the current budget climate means that few Federal agencies will be given increases in their budgets in the coming year. In my brief tenure as Director, I have become more certain than ever that NSF is an exceptional agency, and one that can provide rich dividends on this investment.

You will notice in our budget justification material that the first budget summary presented after the account information is a summary of both interagency and

NSF strategic areas, rather than a summary by budget activities or research disciplines.

This is not coincidental. It reflects an approach to planning that places increasing emphasis on research and education that is relevant to national priorities. It is worth noting that of the incremental funds available for NSF, more than 75 percent will go for research and education in the following strategic areas:

- Global Change Research (up 46 percent to $207 million)
- High Performance Computing and Communication (increased 23 percent, to $328 million)
- Advanced Manufacturing Technology (up $8 million to $196 million)
- Advanced Materials and Processing (up $2 million to $313 million)
- Environmental Research (increased to $156 million, up by 9 percent)
- Biotechnology (increased to $206 million, a $6 million increase)
- Civil Infrastructure Systems (Up 6 percent, to $54 million)
- Science, Mathematics, Engineering and Technology Education (a 4% increase, to $650 million)

The concentration of the budget increase in these areas emphasizes the President's priorities for investing in research that will allow the United States to maintain world leadership in science, mathematics and engineering, while at the same time providing the basis for long-term economic growth that protects the environment.

The growth rates in these areas reflect many considerations. For example, even though the Science, Mathematics, Engineering and Technology Education activity shows only a 4 percent increase this year, it has grown by nearly 30 percent since 1992. In providing slower growth this year, we have an opportunity to look at the progress we have made, consolidate our efforts, and consider the best opportunities for future investments.

I also want to stress that the funding increases in these priority areas have implications for many programs. For example, much of the work supported in the agile manufacturing program is possible only because it is closely coordinated and integrated with work that is funded through high performance computing and communications. This synthesis of new discoveries from different research areas makes for very exciting programs, but we have to look beyond the budget numbers to appreciate the rich connections between programs.

Science Making a Difference

The scope of work that NSF is supporting and the speed with which new findings can affect our lives is nothing short of remarkable.. Let me offer some examples that have come to my attention in just the past few months.

Last October, Business Week magazine reported on NSF funded research on bacteria that can digest oil. The discovery of these bacteria provided hope that they might be a significant factor in reducing the environmental damage caused by oil spills. Unfortunately, when they ingest oil, they become heavy and sink below the surface where they can no longer work on dissolving the oil. NSF funded researchers have reported successful efforts to modify the genes of these bacteria to give them floatation chambers that allow them to remain on the surface, where they can continue to digest the oil.

NSF-sponsored fundamental research has generated the knowledge and understanding to enable businesses to develop products and processes that can have world-wide markets. In the very short time that biotechnology based on recombinant DNA has been in existence, it has grown to a $4 billion a year industry. By the end of the decade, it is expected to account for $15 billion in sales by U.S. companies.

In a totally different realm, the High Performance Computing and Communications program has been a leader in supporting research on massively parallel computing. This involves hooking up large numbers of small computers that break problems down into small parts and work on them simultaneously.

When it was first proposed, massively parallel computing was viewed as an interesting theoretical approach that was not particularly practical. This was because existing computer programs were designed for main-frame computers rather than multiple smaller processors, so most problems were conceptualized accordingly.

NSF invested in developing massively parallel computing, even though its utility was uncertain and the type of problem it could solve was thought to be rather limited. In the course of a few years, this approach has already found applications in areas ranging from materials fabrication to aerodynamics. One unexpected benefit has come in the area of securities analyses. By enabling brokers to more efficiently match borrowers to lenders, costs for mortgages have declined from an average of 3% over U.S. Treasury yields in 1986 to an average of 1.6% today. This increased efficiency has lowered the real cost of housing for every family that has acquired a mortgage in recent years.

Another recent example is the California earthquake on Martin Luther King Day, which inflicted massive destruction on a densely populated region of the state. But the damage might have been much worse had not 250 of California's bridges been retrofitted to better withstand earthquakes. The retrofit designs were based on research conducted with NSF's support as part of the National Earthquake Hazard Mitigation Program.

Finally, a very recent progress report on our Alliances for Minority Participation program indicates that we are making genuine progress in boosting the science, engineering and mathematics enrollment of underrepresented minorities. We began the AMP program in 1991 at a time when under-represented minorities accounted for about 14,000 BS degrees in science, engineering and mathematics annually. We set a goal of increasing this to 50,000 by the year 2000.

We have funded 15 AMP consortia so far (six in 1991; five in 1992; and 4 last November) and the aggregate minority SEM baccalaureate production for the first two AMP programs has increased by over 15 percent. This translates to 1,500 additional baccalaureate degrees going to minorities.

Each of these examples shows how leading-edge research and education can be quickly applied to solve real-world problems. An important question to NSF is how do we improve these connections while still maintaining excellence in fundamental research. We need to continue to build these links, not so much by changing the research we support, but by changing how we think about, organize, and evaluate what we do. Our budget request emphasizes the coordination of our research to align it across disciplines and into programs that reflect national priorities. We need to concentrate on ways to provide better coherence between NSF-supported research and the implementation of well-articulated national goals.

Providing an Accounting

We continuously evaluate our programs in terms of their excellence and their progress in meeting broad programmatic goals. We are also paying greater attention to measuring how the research we support is used. By organizing our activities in ways that emphasize relevance to national priorities, we can develop the necessary connections between the academic community, industry, and public policy.

At the same time, we must continue to nurture areas that do not appear to be immediately relevant to specific goals, but that are scientifically important and always hold the potential for exciting future applications.

How will we know we're doing the right research and education? Part of the answer will come from our ongoing evaluation efforts. Part of the answer also depends on our developing better relations with our customers and doing better at explaining NSF's mission to the public. Much of what we fund is on the edge of uncertainty. Much is intended to fill gaps in our knowledge or provide the means for future exploration. We can do better, however, at evaluating our mission and products, particularly in areas where the results of research can be more efficiently streamed into the user community.

One strategy for accomplishing this goal is to continue to encourage more partnerships. Our already successful efforts in this direction span nearly 20 years, and the lessons we have learned are being used as we develop new ways to link academic researchers with their industrial counterparts.

The most telling measure of success in these efforts is the willingness of industry to commit to sharing in the funding of these research activities. In our Engineering Research Centers, the industry contribution represents about 2.5 times the NSF contribution.

At our State/Industry/University Cooperative Research Centers there are 168 companies working with over 600 faculty and students on research topics relevant to the regional economy . The companies involved contribute over $10 million annually to these cooperative ventures, more than three times the NSF investment. At our Industry/University Cooperative Research Centers, NSF's contribution is leveraged 7 times by industry and this leveraging effect increases to 15-fold when all sources of support -- industry, universities, and states -- are considered.

We have also formed partnerships with 25 states and Puerto Rico through our Statewide Systemic Initiatives to develop comprehensive changes in their educational systems. This systemic approach has been extended with our Urban Systemic Initiatives -- focusing on cities with large numbers of at-risk youth, and the Rural Systemic Initiatives, which addresses the special needs of economically disadvantaged rural regions. Each of these systemic reform activities has a built-in evaluation requirement that is reviewed as an integral part of the proposed initiative.

I am committed to expanding our efforts to evaluate our programs, both those that reflect strategic areas and those directed toward the discovery of new knowledge that expands our understanding of nature. Better evaluation is critical if we are to insure that our programs accomplish what they intend and continually renew the public trust in what we do.

Academic Research Infrastructure

Let me touch briefly on a very important item in our budget request that I know is of particular interest to the committee. This is the request for academic research infrastructure -- the repair, renovation, or modernization of research laboratories and instrumentation.

For a number of years the need to modernize the academic research infrastructure has been apparent. The cost for identified renovation and upgraded facilities has been estimated as high as $10 billion. To put this in context, if NSF were to attempt to meet this need in the next 20 years, it would consume about a fourth of our research funds -- assuming that no new facilities requirements develop during that time. Clearly the need goes well beyond our resources. To provide more than nominal assistance for academic facilities would seriously skew NSF's highest priority -- putting people first.

NSF continues to collect information on the repair, renovation and construction requirements from the universities and colleges across the country. Our next report will be available next September and will provide an accurate and up-to-date assessment of needs.

The National Science and Technology Council may provide an appropriate mechanism to assess the condition of the Nation's academic research infrastructure and possible Federal responses. I believe that we need a multi-agency program for investment in academic infrastructure that will select proposals through merit review. In fact, the Committee on Fundamental Science, which I co-chair with Harold Varmus and M.R.C. Greenwood of OSTP, is proposing a subcommittee on Research Infrastructure as one of its three standing committees.

If we are to provide more than a band-aid solution to the academic research facilities problem, the cooperation of all Federal agencies that fund academic research is needed. Our budget request for Academic Research Infrastructure is the same as it was last year, and will allow us to continue upgrading facilities while we work to develop a more inclusive approach.

The budget request for NSF for the coming fiscal year provides support for carefully considered research and education activities that are reflective of our national priorities. The emphasis in the budget is on supporting excellent fundamental research in areas that are clearly linked to concerns about the environment, civil infrastructure, manufacturing, materials, biotechnology, computing and communications technology, and education. Our budget provides connections across these areas that allow each to build on the work of the others. It represents an integrated plan that is much more than the collection of individual research activities contained within it.

I look forward to working with you and your committee to make NSF's contributions to the nation even more significant in the future than they have been in the past.

Thank you. I will be pleased to respond to any questions that you might have.

ACTIVITY SUMMARIES

Funding for the National Science Foundation is provided through the following seven appropriations.

Research and Related Activities

The FY 1995 Request for Research and Related Activities (R&RA) is $2,348.70 million, an increase of $185.0 million, or 8.6 percent, over the FY 1994 level /1. R&RA funds a broad range of activities focused on strengthening the nation's scientific, mathematics, and engineering research enterprise. Included is support for research projects, centers, instrumentation, user facilities necessary for forefront research, and education and training activities. Also included within R&RA is support for research in the arctic and antarctic regions, and the necessary logistics and operations support to enable such research.

Within R&RA, funding for research and education in strategic areas increases by more than 12 percent over the FY 1994 planned level. Efforts in these strategic areas produce the knowledge necessary to address a range of national priorities, to advance our understanding of scientific phenomena and technological processes, and to strengthen the science and technical workforce. Significant increments include:

- **U.S. Global Change Research Program** increases by more than $65 million, or 46.2 percent, for a total of $207.52 million. Special attention will be given in FY 1995 to major international data collection and analytic programs; to climate change modeling and forecasting activities; to research on terrestrial ecology; to research on policy processes; and to the advancement of methods for conducting integrated assessments.
- **High Performance Computing and Communications** initiative increases by more than $61 million, or 24.5 percent. This includes more than $50 million for **Information Infrastructure Technology and Applications** for information infrastructure services, system development, intelligent interfaces, and National Challenge Applications Problems in areas which have broad impact on the nation's competitiveness.

1/ The Major Research Equipment (MRE) appropriation is proposed in FY 1995 to fund the construction of the Laser Interferometer Gravitational Wave Observatory (LIGO) and the Gemini 8-meter telescopes, currently funded through R&RA. For comparability, the FY 1993 and FY 1994 amounts for these construction projects are included under MRE.

- Support for the interagency **Science, Mathematics, Engineering and Technology Education** initiative increases by more than $9 million, or 8.4 percent, to $118.53 million. R&RA-funded education programs are directed primarily at post-secondary education. Increased support in FY 1995 focuses primarily on improving undergraduate education.

Significant support is also provided within R&RA for efforts in strategic areas including **Advanced Manufacturing Technology**, **Environmental Research**, **Advanced Materials and Processing**, **Civil Infrastructure Systems**, and **Biotechnology**.

Funding for fundamental research in all disciplinary and cross-disciplinary fields of science and engineering supported by NSF will continue. Within R&RA, research project support increases by 10.7 percent to $1,404 million. Examples of projects supported include:

- Investigators funded by the Biological Sciences Activity have isolated a key gene controlling the intake of potassium and of toxic metals in plants. This research may lead to the development of genetically engineered plants capable of blocking toxic metals responsible for major agricultural losses from entering plants.

- Data from the 1993 floods in the Upper Mississippi Basin are being used by researchers funded through the Geosciences Activity to protect river systems against bank and levee sloughing and to determine the degree to which major floods recharge aquifers mined by irrigators and industries.

- Research in the formal methods for the design and analysis of fault-tolerant, real-time, distributed systems supported by the Computer and Information Science and Engineering Activity were applied in the national Air Traffic Control system in the form of the hand-off protocol used to transfer ownership from one air-traffic controller to another.

- The Nobel Prize in Physics for 1993 was awarded to NSF-grantees Joseph Taylor and Russell Hulse for their discovery of the first binary pulsar and for subsequent studies leading to high precision tests of Einstein's theory of gravitation.

- One of the greatest challenges for the chemist is the design of molecules and methodologies that mimic nature. Particularly exciting developments supported by NSF's Chemistry Subactivity are "chemzymes," small molecules with catalytic activities rivaling those of enzymes, and self-replicating molecules designed at the Massachusetts Institute of Technology, taking lessons from DNA.

- Companies have used results from research on human cognition funded through the Social, Behavioral and Economic Sciences Activity, as it unfolds through language, memory, problem-solving, decision-making, and learning, to improve human/machine interfaces.

Funding for centers within R&RA increases by 4.6 percent for a total of $186 million. Activities include:

- When earthquakes occur, such as the recent Northridge, California earthquake, the NSF-supported Southern California Earthquake Center serves as a center to capture data, coordinate science activities, and provide public information.

- The NSF-supported Industry/University Cooperative Research Center for Measurement and Manufacturing Control at the University of Michigan developed a measurement methodology which allowed Chrysler's Jeep Grant Cherokee Plant to improve the dimensional tolerance of the assembly of automobile body panels to 2 mm, a tolerance standard used by Toyota Motors.

- Experiments at the Cedar Creek Long Term Ecological Research site in Minnesota demonstrated the importance of biodiversity on plant production following the major drought of 1988. Areas previously manipulated to contain high plant diversity maintained higher plant production during the drought and recovered more rapidly than less diverse areas.

- The NSF-supported Center for Ultrafast Optical Science has helped bring ten new products to market in its first three years, with sixteen others under development. The Center is now poised to launch the Ultrafast Development Laboratory where scientists and engineers from private companies will conduct experiments related to product development along with Center students.

Support for facilities within R&RA increases by 6.0 percent to a total of $559 million. Activities have included:

- More than 1,200 U.S. colleges and universities are fully connected to the Internet, with traffic carried by the NSFNET Backbone Service in December 1993 almost double that carried a year before.

- The four NSF-supported Supercomputer Centers continue to provide over 8,000 users with access to state-of-the-art computing resources not available elsewhere. Their Centers' scope has expanded to include partnerships permitting private sector organizations to experiment with the application of high-performance computing technologies.

- Since its creation in 1960, about 30,000 people from 250 institutions across the country and around the world have visited the National Center for Atmospheric Research and used its facilities, including aircraft, supercomputers, and ground-based observing facilities.
- NSF funding for the three major national facilities in astronomy supports operations, maintenance, and development of instrumentation in ground-based optical and radio astronomy.
- Facilities supported throught the U.S. Polar Programs enable research in the Antarctic by providing the necessary infrastructure for scientists, including aircraft, research vessels, research stations, and logistical and operations support.

Funding for education and training activities within R&RA increases by 5.2 percent to a total of $199 million. Efforts include support to provide research experience for undergraduate students, reform undergraduate curriculum, explore innovative educational delivery systems, experiment with innovative applications of technology for educational activities, increase the involvement of women and underrepresented minorities through special programs and mentorship activities, provide doctoral dissertation support in research areas requiring field work, and allow faculty at small colleges to update their skills.

Highlights of R&RA by Activity are:

- The **Biological Sciences** (BIO) Activity promotes understanding of the underlying principles and mechanisms governing living organisms. Research areas include analyses of the genetic and molecular processes underlying all life; the use of cutting-edge tools to understand organism development and behavior; modeling of the interrelationships among organisms and the environment in which they live; and the development of new instruments and databases for the biological sciences. The 9.1 percent increase in FY 1995 will primarily support research in the U.S. Global Change Research Program and High Performance Computing and Communications, allowing enhanced support for research on biodiversity and the environment, Long Term Ecological Research sites, and the establishment of a Center for Ecological Analysis and Synthesis.
- Research in the **Computer and Information Science and Engineering** (CISE) Activity is directed at information processing in the broadest sense, ranging from fundamental theory of computing to systems architecture and engineering. In addition, significant attention is devoted to advanced computer and communications facilities providing services for the general research and education community. The 13.7 percent increase in FY 1995,

directed toward the High Performance Computing and Communications initiative, enhances support for its Information Infrastructure Technology and Applications component, increases high performance computing capabilities at NSF Supercomputer Centers, and provides for a transition to very high-speed networking.

- The **Engineering** (ENG) Activity promotes the progress of engineering and increases its potential to respond to the nation's future technological opportunities and needs. ENG accomplishes its mission by supporting all fields of engineering education and research and by developing the nation's engineering human resources and physical infrastructure. Engineering's 9.7 percent increase for FY 1995 will go to support increases in Advanced Manufacturing Technology and High Performance Computing and Communications, and to meet mandated levels for the Small Business Innovation Research (SBIR) program.

- The **Geosciences** (GEO) Activity supports research to advance knowledge of the properties and dynamics of the planet Earth including: studies of geologic forces and their history; ocean dynamics and resources; and the physics and chemistry of the atmosphere. The 9.7 percent increase in FY 1995 reflects emphasis on the U.S. Global Change Research Program and will enable new and enhanced efforts in international data projects, forecasting and climate modeling, terrestrial ecology, and integrated assessments.

- The **Mathematical and Physical Sciences** (MPS) Activity supports research in mathematics, astronomy, physics, chemistry, and materials science to accelerate the growth of the knowledge base and to connect it to potential users. Major equipment and instrumentation such as accelerators and telescopes are provided to support the research needs of individual investigators. The 6.3 percent increase in FY 1995 will strengthen support and boost MPS participation in all interagency and NSF research initiatives and enhance support for facilities and instrumentation.

- The **Social, Behavioral and Economic Sciences** (SBE) Activity stimulates scientific progress in the social, behavioral and economic sciences. Research focuses on how various social and economic systems are organized and operate and how cognitive and cultural factors influence human behavior. The Activity also includes programs that promote international scientific cooperation and provide authoritative data on science and engineering and the characteristics of the nation's research and education enterprise. The 14.6 percent increment in FY 1995 will primarily support the U.S. Global Change Research Program.

- Polar Programs, which includes the **U.S. Polar Research Programs** and **U.S. Antarctic Logistical Support Activities**, support multi-disciplinary research in arctic and antarctic regions. Polar regions play a critical role in world weather and climate and provide unique research opportunities from the ocean bottom through the ice layer and into space. Special logistical and operations efforts are required to support research in Antarctica because of its remote location and the necessity of providing all infrastructure. The 2.1 percent increase in Polar Programs will be directed entirely to research projects rather than logistics. This represents an 8.8 percent increase in research and will enable expanded studies in arctic and antarctic regions, focused primarily on global change and environmental issues.

- The **Critical Technologies Institute** is a Federally-Funded Research and Development Center that provides analytical support to the Office of Science and Technology Policy by identifying near-term and long-term objectives for research and development; analyzing the production capability and economic viability of technologies; and providing options for achieving R&D objectives.

Education and Human Resources

The FY 1995 Request for Education and Human Resources (EHR) is $586.00 million, an increase of $16.40 million, or 2.9 percent, over the FY 1994 Current Plan. EHR supports a cohesive and comprehensive set of activities, augmented by informal science experiences, which encompass every level of education and every region of the country. EHR plays a major role in science, mathematics, engineering and technology education, funding about thirty percent of the total federal effort in FY 1995.

- Support at the **K-12** level totals $360.05 million, an increase of $8.87 million over FY 1994. Included in this amount are **Systemic Reform** activities ($86.06 million) in states, urban and rural areas, and programs to meet the National Education Goals in science and mathematics, established in 1990 by the President and the nation's governors.

- Support at the **Undergraduate** level is $102.25 million, an increase of $2.44 million over FY 1994. This support focuses on the continued efforts of reforming curriculum and laboratory instruction, and upgrading equipment. Improving undergraduate preparation of K-12 teachers and addressing advanced technician training continues to be major emphases.

- Support at the **Graduate** level is $63.39 million, an increase of $4.60 million over FY 1994. Included in this support is a modest increase in both the stipend and the cost of education allowance for the Graduate Fellowship program. The number of fellows will be sustained at approximately 2,400. The Graduate Traineeship program will be sustained at the FY 1994 level.

- **Advanced Technology Education** (ATE) established in FY 1994, is $17.60 million, an increase of $3.00 million over the FY 1994 level. ATE promotes improvement in advanced technological education curricula and instruction to help in the transition of students to the high-performance workforce. The increase will support new centers and expansion of curriculum projects.

Academic Research Infrastructure

The FY 1995 Request for Academic Research Infrastructure is $55.0 million, a decrease of $50.0 million from the FY 1994 Current Plan level of $105.0 million, but the same level requested in FY 1994. Because academic infrastructure needs are so pervasive, only with the concerted cooperative effort of every agency that funds academic research, and with the support of the Congress, can the federal government begin to address the large scale modernization and instrumentation requirements of our science laboratories and classrooms. The $55.0 million Request is the amount NSF feels is sufficient to allow the continued upgrading and improvement of research facilities and instrumentation at academic institutions, while maintaining the Foundation's traditional role in the research community.

Major Research Equipment

The FY 1995 Request for the new Major Research Equipment (MRE) appropriation is $70.0 million. MRE is established in FY 1995 to provide funding for the construction of major research facilities that provide unique capabilities at the cutting edge of science and engineering. Currently funded through the Research and Related Activities (R&RA) appropriation, these construction projects totaled $34.07 million in FY 1993 and $52.00 million in the FY 1994 Current Plan. The FY 1995 Request of $70.00 million represents an $18.00 million increase, or 34.6 percent, over the FY 1994 level for these items.

Projects supported by this Account will push the boundaries of technological design and will offer significant expansion of opportunities, frequently in totally new directions, for the science and engineering community.

Two projects currently comprise the Major Research Equipment Account: the Laser Interferometer Gravitational Wave Observatory (LIGO) and the Gemini

Telescopes, twin 8-meter telescopes in the northern and southern hemispheres being built through an international partnership.

Salaries and Expenses

The FY 1995 Request for Salaries and Expenses (S&E) is $130.72 million, an increase of $12.42 million, or 10.5 percent, over the FY 1994 Current Plan level of $118.30 million. The Request level fully funds the Foundation's staffing requirement of 1,243 full-time equivalents and will enable NSF to exercise effective management of its programs and activities and to continue its investment in advanced information technology.

Salaries and Expenses provides funds for staff salaries and benefits, and general operating expenses necessary to manage and administer the NSF. Funds are requested separately for the Office of Inspector General and for NSF Headquarters Relocation, the appropriation account which includes funds to reimburse the General Services Administration (GSA) for expenses incurred to relocate the Foundation to its new Headquarters location in Arlington, Virginia.

NSF Headquarters Relocation

The FY 1995 Request for NSF Headquarters Relocation is $5.20 million, equal to the FY 1994 level. This appropriation account provides annual reimbursement to the General Services Administration (GSA) through FY 1998 for expenses incurred by GSA pursuant to the relocation of the National Science Headquarters to Arlington, Virginia, which was completed in January 1994.

Office of Inspector General

The Office of Inspector General (OIG) was established to promote economy, efficiency, and effectiveness in administering the Foundation's programs; to detect and prevent fraud, waste, or abuse within NSF or by individuals that request or receive NSF funding; and to identify and resolve cases of misconduct in science. The FY 1995 Request for the OIG is $4.38 million, an increase of $0.38 million over the FY 1994 level.

NSF VISION

Mr. STOKES. Thank you very much, Dr. Lane. We appreciate your opening remarks.

Let me begin by asking you a general question. Please try and capsulize, let's say, the one or two most important issues today facing the National Science Foundation and what your vision for the Agency would be during your tenure.

Dr. LANE. Well, I think, Mr. Chairman, that one thing we must do is to preserve what the Agency has done very well, the core values of the NSF and the community it supports. So these important things like merit review, including peer evaluation of investigator-initiated proposals, the partnerships that we formed and have operated so successfully, the focus on excellence and holding to the highest standards, the decision-making that the NSF is involved in, I think those things I will call core values, must remain in place, whatever change may occur.

But it is important to recognize the world has changed, and it is changing rapidly. The President's investment strategy includes a very important role for science and technology and we must be sure that the NSF participates in that strategy in the most effective possible way. So I think it is important for us to examine ourselves. It is time for the NSF to step back, take a look at what it is doing and how it is doing it.

I have put in place a strategic planning process with a committee chaired by Luther Williams, who is the Assistant Director for Education and Human Resources. This committee is made up of the other assistant directors and the program officers within the Foundation.

That committee will be supported by working groups and be staffed by an office and will be charged—within this new context, if you like, within this evolving new paradigm for research in this country—identify goals for the NSF, a vision for the NSF that incorporates those goals, and criteria for setting priorities, including how much involvement should we have with industry, how important are these partnerships and how can we make them more effective. And in general, to simply be sure that our programs, research programs, education programs, in fact, are the ones that can enable the NSF to be such an important player in this science and technology strategy.

Right on the heels of that, we will have an internal planning effort to make sure that the way we are doing business is efficient and effective. It is consistent with the Vice President's National Performance Review. It is part of "Reinventing Government," and we feel it is time to do that as well.

I would mention that Dr. Duderstadt has put in place an ad hoc planning committee of the Board which will work closely with the NSF staff effort and we expect to have a full discussion of the strategic plan this summer. So I think the challenge to the NSF is within this changing world, a different focus on how science, engineering, and mathematics is going to help the Nation, and with the universities looking at themselves and the role that they play, continue to play importantly in moving the Nation forward.

It is prudent for the NSF at this time to have a good hard look at what it is doing and how it is doing it.

Mr. STOKES. In carrying forth this type of a vision, do you anticipate any organizational changes within the Agency?

Dr. LANE. I think the Agency, as you know, Mr. Chairman, has evolved through time. There are raw directorates that weren't there when I was there 13 years ago, and they are there for good reason. It is because of change that this occurs. It has occurred in an evolutionary way, and as a part of this planning process we certainly will be looking at the organization of the NSF.

There already are crosscutting, organizational threads that run through the NSF to keep track of these strategic initiatives, for example. What is our—excuse me. What is our program in high performance computing and communications? How is it managed? What are its components? How are the funds invested? Those kinds of horizontal links, if you like, will continue to play a very important role in our structure.

STRATEGIC VS. APPLIED RESEARCH

Mr. STOKES. You talked about your strategic plan and strategic areas. Can you explain the difference between strategic and applied research?

Dr. LANE. Well, I think the words have caused us a good bit of difficulty, Mr. Chairman. I certainly stepped in a few potholes myself on these words. The way I prefer to describe the investment of funds for research that will help the Nation with some of its more immediate needs is to talk about basic research in strategic areas. This means that if you ask what the researcher is really doing in the laboratory on a day-to-day basis, the researcher, he or she, is asking very fundamental questions about the workings of nature, or in the case of engineering, about the working of things made by humans.

But these are very fundamental questions. The emphasis is on discovery. It is expected that one will discover new knowledge, one will discover new ways of doing business, and in the process, of course, for the students that are involved, it is an incredible educational experience. So it is basic in that sense, the basic questions are being asked. You don't know for sure just where a project will lead. But if you are doing that basic research in an area of atmospheric chemistry, for example, you want to understand something about the interaction of molecules in a particular region of the atmosphere.

You can reasonably expect that the knowledge coming from that particular investigation and others like it, collectively will advance our understanding of the environment, in particular global climate change. And so that would be strategic. In that sense, I would call global change a strategic area. But the things that NSF would support would be quite discovery-oriented.

BASIC VS. APPLIED RESEARCH WITHIN STRATEGIC AREAS

Mr. STOKES. In light of your response, how much of the requested funding for strategic initiatives in fiscal year 1995 is for basic research and how much is for applied research?

Dr. LANE. Well, I think of the increment going into 1995, as we have said, about 75 percent is for strategic research. But I would argue that essentially all of that is basic in the sense that it is going to be invested in the work of scientists, mathematicians and engineers who are trying to discover new knowledge. But it will be new knowledge in areas that support strategic initiatives, like global change; high performance computing; civil infrastructure; biotechnology; and the other such areas; and, of course, in one of our most important programs, the Science, Math, Engineering and Technology Education Program that Dr. Williams, working with the other assistant directors, manages.

Mr. STOKES. Dr. Duderstadt, are you in accord with this move towards strategic areas as being the right direction at this time for NSF?

Dr. DUDERSTADT. I think the National Science Board is quite supportive of it. If you go back to the activity almost half a century ago, which led to the formation of the National Science Foundation, it was with the idea in mind that the research conducted by the Foundation, the people that it would produce, would have an impact on major national needs, needs of the time. That is part of the social contract. That is why the public supports agencies like the National Science Foundation.

While much of the basic research—while much of the activity of the Foundation is basic in nature, it is in areas that do relate to national objectives. And the National Science Board supports this, recognizing that the research is fundamental, but the National Science Foundation does have some obligation to contribute to meeting the needs of the Nation.

CRITERIA FOR STRATEGIC RESEARCH

Mr. STOKES. Dr. Lane, I note in your testimony that of the incremental increases, more than 75 percent will be for research and education in certain strategic areas. Tell us what criteria you used to determine which initiatives are strategic.

Dr. LANE. Well, the identification, Mr. Chairman, of strategic is in part those initiatives that are—have been—arrived at through interagency cooperation and some of which have evolved, really all of which, I guess, have evolved out of the FCCSET process. The areas of high performance computing and communication, for example, and global change research came out of the FCCSET process. They continue to be very high priorities of the current Administration. And so in a tight budget year we really have made some hard decisions to invest resources in these strategic areas, but not uniformly.

And I said the two that stand out are global change and high performance computing and communications. I mean global change is in for 46 percent increase, high performance computing and communication for 23 percent increase.

GLOBAL CHANGE

Mr. LEWIS. Excuse me, Mr. Chairman. Is global change a new word for global warming?

Dr. LANE. Well, it is a broader term than global warming.

Mr. LEWIS. Sorry, Mr. Chairman.

Mr. STOKES. No, that's OK.

Mr. LEWIS. Semantics are difficult.

Dr. LANE. Well, Mr. Lewis, it is a broader term than global warming, but it certainly includes global warming activities. And as a part of the larger set of issues having to do with the environment and changes in the environment, changes that will affect the lives of people and the effect of the activities of people on that environment, this broad range of issues is clearly an important one to the Nation, but also one in which the research programs that NSF supports can be expected to bear on. Because the one thing one sees when we look at how these funds, global change money, for example, are invested in the Foundation, you will see that it touches many, many programs throughout the Foundation.

One can understand, I gave chemistry as an example, certainly it is going to touch chemistry, but it is also, obviously, important in the geosciences and in high performance computing and communications. Many of these initiatives strongly overlap because of the common threads that run through them.

That creates difficulty for us sometimes when we are responding to a question, such as how many dollars does NSF invest in this particular area, because there is so much overlap. We are working hard to do a better job of responding to such questions. But the investments in these strategic areas touch a lot of what the NSF supports, many different fields. But the rationale is that the investment is in research, the knowledge from which research then can be expected to help advance our understanding of a particular strategic area.

STRATEGIC RESEARCH BUDGET

Mr. STOKES. That brings me to one of the questions that is necessary for our purposes, and that is how much of the total proposed NSF budget is part of your set of strategic initiatives?

Dr. LANE. We feel that over half of our budget is invested in strategic initiatives. The difficulty we have in being more precise is the fact that many of these initiatives overlap, and so it is difficult to pick out a particular project and say that supports only global change. Because you find often a particular project supports global change, education, and high performance computing and communication.

So Mr. Kull, in fact, working with the assistant directors and other staff, are really putting in place a system to track this funding so that we can do a better job of reporting precisely the investment in different areas. But I think it is a fair—it is a fair statement to say that we invest over half of our budget in strategic areas.

Mr. STOKES. Are these initiatives and the funding levels for them the same as you requested of OMB?

Dr. LANE. No, Mr. Chairman, they are not exactly the same as the initial request to OMB, although they are consistent with our priorities as reflected in that initial request. But the precise distribution is not the same as the original request.

INDIRECT COSTS

Mr. STOKES. The Administration has proposed a pause on indirect cost repayments to colleges and universities for the overhead expenses that they incur in carrying out Federal-funded research and development.

Dr. Duderstadt, are you familiar with that proposal?

Dr. DUDERSTADT. Yes. Yes, I am.

Mr. STOKES. Could you comment on this for us?

Dr. DUDERSTADT. Certainly. I comment both as Chairman of the National Science Board and President of a large American university. The National Science Board, and I think higher education more generally, recognize quite clearly their responsibility to participate, to make the necessary sacrifices to move toward Federal objectives such as deficit reduction. However, we believe that the proposed pause in indirect cost reimbursement, which was really proposed without consultation with either higher education or scientific community, is the wrong way to go.

Wrong for two reasons: First, the costs that would not be met through the pause associated with Federal research that is procured by the Federal Government are real costs, for electricity, for heating, for complying with Federal standards and so forth. And if those costs are not met by the Federal Government, they must be met by others. So in reality, the effort to save $130 million or whatever the number is, in reality transfers those costs to students and parents who pay tuition, to State taxpayers who support public institutions, or to other supporters of higher education.

From a broader, more strategic point of view, for almost half a century a very fundamental principle involving the relationship between the Federal Government and universities is that the Federal Government would meet the full costs of research that it sought from campuses. This goes against that at a very critical time when most universities are under very serious financial stress right now, and threatens what has been a marvelous partnership between the Federal Government and the academic research establishment.

For that reason, last Friday the National Science Board voted a resolution pointing out its serious concern with this pause, and suggesting that other mechanisms should be examined if the intent is to save this amount of money in Federal expenditures. And I will introduce that resolution into the record for members of your committee and staff.

As I say, we regard this as a very serious issue, and we think alternative methods should be found for meeting the requirements of fiscal constraints that will not jeopardize the fundamental principle of the partnership between the Federal Government and the academic research enterprise.

Mr. STOKES. Appreciate that. Without objection at this point, we will insert that resolution into the record.

Dr. DUDERSTADT. We would appreciate that.

[The information follows:]

NSB RESOLUTION CONCERNING THE INDIRECT COSTS "PAUSE"

The National Science Board resolution concerning a proposed "pause" on reimbursement of indirect costs of research is attached.

NSB-94-61

RESOLUTION APPROVED BY THE NATIONAL SCIENCE BOARD AT ITS 320TH MEETING ON MARCH 18, 1994 CONCERNING A PROPOSED "PAUSE" ON REIMBURSEMENT OF INDIRECT COSTS OF RESEARCH

Background

The partnership between the Federal government and the nation's colleges, universities and other non-profit performers of research has served the nation well for half a century by producing the talented people and new discoveries that opened up a range of economic opportunities and contributed to meeting a variety of national needs. That partnership is now threatened by a government proposal made without consultation with the research community, one which would have important negative effects on the nation's research enterprise. Recent negotiated changes in the rules for reimbursing indirect costs are already resulting in significant reductions, and there is no reasonable, non-arbitrary basis for further cuts at this time.

The proposed FY 1995 budget would cut Federal costs by approximately $130 million through the application of a "pause" in payment of indirect cost recoveries for grants to the nation's colleges, universities and other non-profit institutions significantly involved in research. The precise mechanisms for the application of this "savings" have yet to be determined, other than that institutions have been informed that they will receive no additional indirect cost reimbursements in the next fiscal year beyond the level that they are receiving in the current year.

Indirect cost payments for Federally funded research efforts are reimbursements for real expenditures that have actually been made by the participating institutions. The refusal of the Federal government to fully pay its previously-agreed share of these expenditures shifts that burden to other sources of institutional revenues, such as tuition, private gifts, and, in the case of public institutions, State appropriations. Not only is such cost-shifting inappropriate, but, for some institutions, may not be possible for legal or organizational reasons.

Payments to academic institutions for incurred indirect costs have already been reduced by changes in the revised OMB Circular A-21, released in spring 1993. Total recovery of legitimate and long-standing administrative costs has been capped at a rate of 26 per cent, even for those institutions that can document larger costs resulting from Federal programs. Furthermore, institutions have been complying with Federal policy that encourages multi-year cost rate agreements -- the results of which would now be put aside as a result of the proposed "pause."

Resolution

WHEREAS, the Report of the National Science Board Commission on the Future of the National Science Foundation declared in November, 1992 that "As a result of the government's reliance on universities for much of the nation's basic research, American graduate education in the sciences and engineering leads the world;" and,

WHEREAS, Federal payments for indirect costs are reimbursements for monies expended by an institution for recognized, legitimate purposes, including compliance with Federal standards and regulations; and,

WHEREAS, one of the longstanding guiding principles for the relationship between the Federal government and the nation's research institutions is that the government pay the full indirect costs of the research it supports; and,

WHEREAS, to expect universities to further subsidize the Federal share of costs legitimately incurred on Federal contracts and grants undercuts the Federal objective of investment in the nation's research enterprise and may shift costs to students, their families and State government taxpayers, and/or reduce the level of the nation's research activity;

Now therefore be it

RESOLVED, that the National Science Board register its strong concern over the implications of the recommendation for a "pause" in the FY 1995 reimbursements to institutions of costs incurred in the conduct of Federally-sponsored research, as inconsistent with the most effective use of Federal resources in pursuit of science and engineering excellence;

and be it further

RESOLVED, that the National Science Board recommends that the Office of Management and Budget work with the Assistant to the President for Science & Technology and representatives of the nation's colleges, universities and other non-profit institutions significantly involved in Federally-sponsored research to identify alternative means of meeting the requirements of fiscal constraints that will not jeopardize the fundamental principle of partnership between the Federal government and research institutions.

WHAT MAKES NSF EXCEPTIONAL

Mr. STOKES. Now, as I noted earlier, NSF was requesting an increase of $182,200,000, or 6 percent above the 1994 level. Although this requested increase is smaller than in previous years, it is still quite high in terms of percent, given the budget constraints that we all face.

In your written statement, Dr. Lane, you say that in your short tenure you have become more certain that NSF is an exceptional agency. Tell us in what respect NSF is an exceptional agency. That is, what makes it different from other Federal agencies?

Dr. LANE. Well, Mr. Chairman, I don't have much experience with other agencies, so I hesitate to try to draw comparisons, but speaking just from the vantage point of NSF, which I have observed over a long period of time having worked there for a year, about 13 years ago, I was struck when I first came to the NSF as a division director for a year in physics at the quality of the people and how hard they work, at the consistent high standards that are applied in making decisions.

I felt that before I went to the NSF, because I know the community considers the process of getting work funded by the NSF a very highly competitive one, and when they review proposals they do it seriously, spend a good bit of time, and the selection process is quite rigorous. But until I was here and had a chance really to work in the place for a year, I didn't really realize why the community had the respect it did for the NSF and why the NSF seemed to be so successful.

I am not sure that I can tell you even now. It has something—a combination of things—to do with the quality of people who have been at the NSF through the years, and who are there now and the fact that excellence remains the highest priority in everything that the NSF does.

This merit review process that has been put in place and has been so successfully applied through the years, with the help of the larger science community, has worked so well. I think the special relationship between the NSF staff and the National Science Board—we are the only agency with an organization like the National Science Board—has been important through the years and I think has probably helped the NSF maintain these core values that are so important to the Agency doing what it does so well.

I think the focus also on education, which has always been there is important, although through some periods of time it was not quite so evident as in other periods. What NSF has always been about is about learning, learning through research done by faculty, learning through students working in the laboratories and in the classrooms, and that is an investment in the future of the Nation that seems, to me, critically important.

So I would argue that because of the quality of the institution, the good job that it does, has done through the years, its reputation throughout the world for the high standards that it sets in decision-making and for the knowledge and methodologies that are produced by its scientists and engineers, and finally for the value of an investment in learning, in the education of young people who really are the future of the Nation, that it is, I believe, a valuable investment, an important investment for the Nation to make at a time when the budgets are very tight.

Mr. STOKES. Let me just follow-up on that. In terms of OMB, do you have some insight into why NSF continues to get such large increases from OMB?

Dr. LANE. Well, I guess I could say that they accept all the things I just said.

Mr. STOKES. Right.

Dr. LANE. I don't know that to be a fact, of course. I think in the current year it was important that NSF had the capacity and the community we support had the capacity to invest in education, human resources development, and in certain of these strategic initiatives that are such an important part of the President's investment strategy.

INCREASES IN HPCC AND GLOBAL CHANGE

Mr. STOKES. Now, you also stated in your testimony that the science and math education activity has grown by nearly 30 percent since 1992, but only by 4 percent this year, and that the slower growth will provide NSF an opportunity to look at the progress made and consolidate efforts.

Given that statement, do you think the increases and rapid expansion of some of these strategic areas, especially global change research and high performance computing, are too great in fiscal year 1995?

Dr. LANE. You mean are those too great? Excuse me, Mr. Chairman.

Mr. STOKES. No. I am talking about the expansion of those.

Dr. LANE. Education is not in for such a large increase, it is right—for a whole program in science, mathematics, engineering and technology education—the increase is 4 percent, and I think 3 percent, in fact, for the Education and Human Resources activity by itself.

I would like to remind the committee that the Education and Human Resources activity supports about 80 percent of all of our activities in science, mathematics, engineering, and technology education, but 20 percent of the activities come directly out of the research directorates. It really is a partnership within the NSF and in the community.

We now, through years of rapid growth, find that the Education and Human Resources activity is about 20 percent of the whole NSF budget. I think that is about right. That is a substantial percentage. And yet, that investment is such a teeny part of the overall expenditure of this Nation in education that it is critically important that our funds be invested strategically, if you like, that they be catalytic in their effect, that they be highly leveraged.

And we think it is appropriate to take a breather here, continue the evaluation of the programs that are underway, and Dr. Williams, I am sure, would be happy to address this in more detail, and make sure that what we are doing is not only good—it certainly is evaluated highly and it is reviewed in the way I described—but that it is really the most effective way to invest these resources in advancing the Nation's development of human resources and the education of the citizens. So we think it is appropriate to take a rest here and see these evaluations through.

I think Dr. Williams will tell you, Mr. Chairman, that this increase is certainly adequate to support the programs that are in place. And I would like for him to be able to comment whenever it is appropriate to do that.

Mr. STOKES. Mr. Lewis, do you want to comment at this time? I yield to you.

STRATEGIC RESEARCH

Mr. LEWIS. Thank you, Mr. Chairman.

Dr. Lane, I appreciate your being with us. Let me begin this by saying that I personally spent some time reviewing the work of NSF over the years. I tend to want to be very supportive. That is not necessarily our role on this committee automatically.

But last year's Senate appropriations report, sent a chill through the academic community. I know that you probably have been exposed to a good deal of that.

The focus was for the Foundation to move beyond rhetorical statements about the value of strategic research. To quote it directly, "In short, the Foundation can be at the heart of shaping the administration's science and technology policy and pursue specific national goals, or it can diminish into becoming nothing more than a national endowment for sciences."

I guess the root of all evil is the semantic difficulty that I mentioned and struggled with. Virtually every program element in the Foundation's budget justification could be analyzed against this basic versus strategic research dilemma.

Let me ask the Chairman's question in a little different way. What does the Foundation want the Congress to understand when it uses the terms "strategic research?"

Dr. LANE. Mr. Lewis, first I appreciate your comments of strong support. Obviously it is important to us. The language of the Appropriations Subcommittee did get the attention of the larger community, and I certainly read the report several times myself early in my time coming aboard.

I think the message in the language, the message I took from the language fairly early on, so it is not something I have really changed my mind about recently, was simply that the reason the Nation invests a significant amount of money in basic research activity is because of the expectation that the results of that research will be important to people, will improve people's lives.

Another message is that it is not so clear that the community that does the research fully appreciates that that is the reason the money is invested. There was—there have been some things said, I think, over the past several years that might suggest that the community considered this money an entitlement. I don't really believe the community feels that way. I think there are lots of opportunities here for misunderstanding in the use of words, but I think that is a message in the report.

Another message, I believe, is that if you say to NSF that you are going to invest $3 billion or $2.2 billion, our funding for research and related activities, in basic research and out of that will come new knowledge and somehow that will be good for people, fine, that is—we understand that. And we won't ask anymore questions or not the same questions.

If you say, on the other hand, that by investing in basic research in these areas you really will advance our understanding of the environment and help us understand better how to protect ourselves from it, how to keep ourselves from fouling it, in every other way protect the environment and the welfare of the people, if that is what you say the basic research is going to do, then we will ask somewhat more difficult questions.

We will say how do you know that the programs you are supporting will contribute knowledge that will help us advance our understanding and help us cope with these larger issues? So I think to the extent that the NSF describes itself as serving these larger national needs and supporting strategic initiatives, then it must also be ready to answer somewhat more difficult questions about how do you know you are doing it and how do you know whether to put more money in it or not.

I am out and about in the community very often and I get asked this question quite a lot about the language, because people are concerned. And what I assure them is that we are not being asked by the Congress, by the subcommittee, to ask a particular scientist to tell us on what day you are going to make a great discovery and tell us when you are a third of the way there or three quarters of the way there. That is not what we are going to ask you and that is not what we are being asked. But collectively across all our programs or broadly across many of our programs we are being asked to explain a little better how the work that we are supporting is really going to impact one or another of these strategic areas.

So I interpret the language as a wake-up call. It is saying, look, NSF, if you are really going to be in the game, if you are really going to say that what you are doing is important in helping the Nation advance in a number of these important agenda, in fulfilling a number of these strategic goals, then you need to be more precise, not overly precise project by project, but just more precise about the impact of your work.

STRATEGIC NATIONAL GOALS

Mr. LEWIS. Jim Duderstadt presented an impressive compendium of items that would reflect the value of results of strategic research. But, Dr. Lane, you suggested that some of the priorities changed with this administration and so there is some shift in the places emphasized. Could you give us a listing of the five strategic national goals of this administration for research funding?

Dr. LANE. I would—the words—might use different words in different circumstances, but the ones I would——

Mr. LEWIS. I can't help it, the Senate report got me to thinking in these terms.

Dr. LANE. The description we outline of the strategic areas would be high performance computing and communication, global change research, environmental research, biotechnology, advanced materials and processing, advanced manufacturing technologies, civil infrastructure systems. And I may have forgotten.

Dr. DUDERSTADT. And education.

Dr. LANE. Of course, education. Education, science, mathematics, engineering and technology education. Those are, I think, in fact, probably the total list as it appears right now. I would want to emphasize that, you know, through the years NSF has and its investigators have realized that the work they support is good for something or other. It will lead to new materials. It will lead to company spin-offs. So that part is not new. What is new, I guess, is the effort to be more precise about it.

INDIRECT COSTS PAUSE

Mr. LEWIS. I have another quote. It is the response that Dr. Duderstadt referred to earlier of the American Association of Universities. "The proposal is bad science policy, bad public policy and flawed budgeting. Do not expect our placid acquiescence to contrived cost shifting. There will be great stress and game playing within the program agencies on the campuses."

That sounds very much like an expected entitlement. Dr. Lane suggested there was not an entitlement as such. There is no doubt that if there was motivation in part besides budget for the pause, it is the discussion that Ray Thornton and I had last year about universities which demonstrated a clear pattern of abuse. And in turn, the community had to pay a price for that.

I did not hear any of that in your statement and I am wondering if there is really an understanding that that has been a problem and people are trying to redefine now, where we should be?

Dr. DUDERSTADT. No, no, I certainly would be the first to acknowledge that there have been difficulties. The rules, policies governing interagency cross reimbursement are complex. There have been mistakes made. I do believe that over the last several years very strong efforts have been made both on the campuses and in Washington to address those issues and to eliminate them. But I come back again to the fundamental issue. The concern here is not the need to save a certain amount of money. I mean, I think we all support that, we are all willing to sacrifice.

The concern here is cost shifting, because right now for most institutions the only resource available to them are student tuition and fees. If they are public institutions, they also have State appropriations, but in most of the States, because of the last several years and the difficulties the States have had, those State appropriations are contracting, and so is private support which is usually earmarked for certain purposes.

So if the Federal Government chooses to procure research, but then say we will not pay the full cost for that, the universities have only one choice, to say, well, we will do the research, but we will have to ask others to pay the costs: students, parents, State legislatures; or to say, we are sorry, but we can't do the research. And I think you will see both responses through this pause.

INDIRECT COSTS SHIFTING

Mr. LEWIS. I halfway wish that you had been with us on the Floor yesterday when we debated the question of bilingual education. Is it a mandate or was it not a mandate. There were those who argued strongly that it is a Federal Government mandate. It is grants programs, as these are grants programs.

The budget for NSF in a shorter time since you were there last, Dr. Lane, has increased by 150.4 percent, not including inflation over a decade. You have had healthy growth. And that somewhat challenges the question of cost shifting. Unless you do presume that even overhead is an entitlement.

Dr. DUDERSTADT. Well, no, what I do presume is that for every dollar of grant support that Federal agencies provide on the average, the universities end up spending more than that to do the research, $1.25, $1.15, it depends on the institution. So although they are grants, the institutions themselves, through cost sharing and through under recovery of indirect costs, are substantially subsidizing federally procured research on our campuses.

The difficulty with this is that on a very short time scale and without consultation it will shift even further costs on the institution at a time when they have no other recourse other than to simply refuse to accept the research, which would be difficult to do since it is stimulated by individual faculty, or to ask others to bear those cost shifts. And right now, unfortunately, those others are primarily students and the parents.

Mr. THORNTON. Would the gentleman yield? Excuse me.

Mr. LEWIS. Sure, sure.

Dr. DUDERSTADT. And we are all desperately trying to get a handle on the rapidly escalating costs of a college education and get those costs under control and provide families with the opportunities to send their kids to college. And having further obligations and burdens passed on from the Federal Government on to that part of university support is a very difficult thing right now to handle.

Mr. THORNTON. Would the gentleman yield?

Mr. LEWIS. Sure.

ROLE OF UNIVERSITIES IN RESEARCH

Mr. THORNTON. I thank the gentleman. I would like to say at the beginning that I am not sure that I can go along with a moratorium or a suspension of funds for indirect costs. But I am troubled by the tone of the letter which has been referred to, because it indicates to me that there may not be an acceptance in the university community that research is part of basic university role and purpose. If there was no Federal money for research at all, do you mean to say that there wouldn't be any research at your university?

Dr. DUDERSTADT. Not in the least. In fact, I think if you look at the statistics, you will find that institutional support of research activities during the 1980s and beyond increased much more rapidly than Federal support did. But that research would be of a quite different nature.

For example, it might refer directly to the needs of the State rather than national needs. And what we are talking about right now, strategic research, research that really is directed toward meeting national needs, that the Federal Government seeks from the academic research establishment, and that is fine, well and good, and I think quite appropriate, but associated with that has been a long established principle that the Federal Government makes every effort to pay for what it procures. And the pause goes against that principle.

POPULATION RESEARCH

Mr. LEWIS. Dr. Duderstadt, the question that Mr. Thornton asked goes right to the point here. Population, burgeoning population, has to be one of the most significant items relative to global change. Does NSF have projects that relate to that?

Dr. LANE. Well, Mr. Lewis, I think I would have to direct your question to Dr. Marrett. Certainly such studies are within the scope of the research activities in the social sciences, and one aspect of global change is—or one expanding aspect of global change research is the sort of human side of global change. And I suspect that that includes population activities. But could I ask, first?

Mr. LEWIS. Certainly. I hesitate to use the term population control, but lest we be shy, it seems to me this is one of the most fundamental questions facing world society in terms of global change.

Dr. LANE. I agree. Dr. Marrett, do we support population research?

Dr. MARRETT. Yes, we have been supporting some research, and particularly in connection with global change research, because there is both the growth in the numbers, and the migration, the movements of people. A part of the plan for 1995 will be to link what we now know about population growth movements to the other dynamics that are both biological and physical levels. So we are saying now there are things that we know, but we don't know fully the way those all come together to affect global change or the way in which these kinds of changes affect population dynamics as well. So that is very much a part of the program.

Mr. LEWIS. Perhaps you could help my staff focus upon the parameters of some of that work. You know, I would be very interested in what kinds of efforts we have made and what people are thinking about.

Dr. LANE. Would you like us to submit something for the record?

ACCOMPLISHMENTS OF K–12 PROGRAMS

Mr. LEWIS. No, just communicate with my staff first. Then we will talk for the record. I don't want to excite anybody around here too much. Support at the K through 12 level totals $360 million plus, an increase of $8.8 million in 1994. Included in this amount are systemic reform activities in States, urban and rural areas, and programs to meet the national education goals in science and mathematics. K through 12, undergraduate, graduate school combined will total $586 million, a little over half a billion dollars.

Can somebody help us for the record or maybe verbally at this point in time. What have we accomplished with those funds since you were last at the agency?

Dr. LANE. Well, I would like to ask Dr. Williams to respond in detail here. I can say that we hear lots of good stories about the impact of our programs. That is not the same as a systematic evaluation of the scope of the whole program. Some of those evaluations have been done and some are underway and perhaps with your permission I could ask Dr. Williams to respond.

Dr. WILLIAMS. Okay. First of all, this is a comment on numbers, a general comment on the numbers. The request is for $586 million; $360 million as you indicated is K through 12, about $100 million of that is undergraduate. The graduate component is like less than $100 million and we have some other special efforts that equal about $50 million.

Mr. LEWIS. I almost expect those numbers would have been reversed in order.

Dr. WILLIAMS. Well, in this context, what I am referring to is education and training. Clearly, the greatest problem area is the epicenter, that is K through 12. The graduate support of graduate education within the epicenter is not restricted to this budget alone. It is a substantial part of the support under research programs, which is enormous. That is not what I was referring to. Impacts, we have done two things. We completed evaluation of six of the 33 programs in the directorate. The result says we are doing quite well with them. In terms of impact, it has allowed us to make some changes.

Under the current fiscal year, we have under review presently, started from last year, an additional six, that equals 12 out of 33. And we will start seven additional evaluations. In other words, nearing the end of this fiscal year, by the middle of fiscal year 1995, we will have an evaluation report that allows us to see the impact in full of 19 of the 33 programs, having started this only three fiscal years ago, costing a couple of million dollars. But in addition to that, we have also done a series of impact studies of each of those programs, particularly the systemic ones; and, in fact, we have a report that is in progress that shows that, which I will be glad to provide the committee once it is approved.

GLOBAL CHANGE AND HPCC

Mr. LEWIS. Well, I am going to be spending a lot of time on global change, so if you would review that first with Mr. Thornton, maybe he can help me out.

Dr. WILLIAMS. Okay, all right.

Mr. LEWIS. Thank you, Mr. Chairman.

Mr. STOKES. Sure. Mr. Mollohan.

Mr. MOLLOHAN. Thank you, Mr. Chairman. Dr. Williams, I note the Chairman and Congressman Lewis have touched on some of these issues. But I would like you to comment a bit more, if you would.

I notice that you have a 23.1 percent increase in the HPCC program, and you have a 26.2 percent increase in your global change program.

Dr. LANE. 46.2, Mr. Mollohan.

Mr. MOLLOHAN. I see, 46.2 percent. Those are really bold increases, especially since your overall increase for NSF is for 6 percent. I personally appreciate the importance of these two initiatives, but they are dramatic increases in your budget. Why such dramatic increases in those areas?

Dr. LANE. I think, Mr. Mollohan, those two initiatives are among the more mature initiatives of the program. They did come out of the strategic activity. They remain very high priorities of the Administration. The dollar increase in 1995 is roughly the same for those two programs, but because the base is so much smaller in one, the percentage is higher.

The two interact with one another and they are mutually supportive and they also are much involved in many of the other programs within the NSF. I think the reason for the substantial increase in these areas is that they are mature programs.

NSF plays a key role in making progress in these areas. NSF, working with other agencies over a number of years, has mapped out a strategy to make progress in these areas. And this year and in 1995, NSF has the capacity to support a good bit of research in that area and using the same standards of review and decision that it has applied in past years. So they are special in a number of ways.

INTERAGENCY COOPERATION IN HPCC

Mr. MOLLOHAN. To what extent are you cooperating with other agencies? Are you considering proposals together and considering joint funding of proposals together?

Dr. LANE. If I could, Mr. Mollohan, I would like to ask a couple of my assistant directors to comment on this specifically with regard to the programs. And maybe Mel Ciment, who is our Acting Assistant Director for Computer and Information Science and Engineering, can comment on that.

Dr. CIMENT. I would like to add to the words of the director in reference to why we are expanding the HPCC program at this time. In fact, there are several opportunities in terms of the interagency planning in high performance computing that have matured at this point. The computationally intensive aspects of the original part of the program that were emphasized over the last three years have now become the bedrock, you might say, for the next level of the National Information Infrastructure initiative that the President has endorsed as a vision for the future. And so part of the—approximately one-half of the increment that we have in HPCC this year is devoted to the component on information infrastructure technology and applications.

These are the information-intensive applications that support many enterprises in the country. They are in contrast to the computationally intensive aspects of computational science, the grand challenges that we have done previously.

Mr. MOLLOHAN. Could you give us a couple examples?

Dr. CIMENT. Yes, one of the initiatives that we have this year is, in fact, digital libraries. We have a program announcement that went out and received over 70 proposals. What we are going to fund here are information retrieval aspects, information technology storage and visualization and knowledge, machine interfaces, to understand the information and transport it, integrate it into all sorts of enterprises.

Mr. MOLLOHAN. Private sector enterprises?

Dr. CIMENT. Private sector is involved dramatically in this in the sense that we have consortia, libraries, museums, all sorts of information processing companies that are involved, publishers, and libraries.

INTERAGENCY HPCC SUPPORT

Mr. MOLLOHAN. What part are you supporting with your grants?

Dr. CIMENT. This is a very good example of your other question about how this relates to the other agencies. This is jointly funded with NASA and with ARPA, each at approximately one-third, each of us are putting in the money for this initiative this year in 1994.

In the 1995 budget, we have requested an increment for that. But that will add to these consortia and cross diverse application areas.

Mr. MOLLOHAN. Is Commerce in that particular one?

Dr. CIMENT. In this particular announcement, we only have the three agencies.

Mr. MOLLOHAN. What part are you funding?

Dr. CIMENT. We will be funding, of course, the basic research aspects and also the more generic applications. NASA will be looking towards applications specific to their interests. But there is overlap in multidisciplinary environments. You have to create tools and interfaces and all sorts of services and many of these basic research aspects apply generically across many different information-intensive enterprises.

Mr. MOLLOHAN. How are you interfacing with the private sector? Are you funding any of their participation in this?

Dr. CIMENT. They will be part of the proposals, yes.

Mr. MOLLOHAN. Will they be coming up with their own money?

Dr. CIMENT. They will be providing cost sharing. Cost sharing is part of this particular initiative.

INITIATIVE PRIORITY

Mr. MOLLOHAN. As you know, money is tight. If we aren't able to fund all of NSF's request this year, do these two initiatives have a priority?

Dr. LANE. Well, I think if our increase is less than 6 percent, it certainly means we have to look again at what investment we are able to make in these two particular areas we have been talking about, but also in the other areas that I referred to. I think certainly that whatever we do will be consistent with these priorities that we are describing, but if the number goes down, then we have to revisit the specific allocations.

Mr. MOLLOHAN. If you didn't get a 6 percent increase, would these two programs have a priority?

Dr. LANE. I would still expect these two programs would have a clear priority. We would still want to implement as much of the work as a part of these two important cross-agency efforts.

Mr. MOLLOHAN. Would these be two you want funding before some others? Would you want these programs to get these increases even if you weren't able to get an overall increase of 6 percent?

Dr. LANE. Not necessarily at the levels that we are talking about right now, but certainly at higher levels than would be the average for the Foundation.

EPSCOR

Mr. MOLLOHAN. Okay. I would like to ask you a couple questions about EPSCoR, please. You requested $31.9 million, the same as last year, for your EPSCoR program. Could you talk with us how that will be divided among your various EPSCoR programs, both for fiscal year 1994 and how you plan to spend the money in 1995?

Dr. LANE. I would like to refer that to Dr. Williams, if I could, Mr. Mollohan.

Mr. MOLLOHAN. Certainly.

Mr. MOLLOHAN. We appreciate Dr. Williams' efforts.

Dr. WILLIAMS. Each of the EPSCoR participants, the 18 States and Commonwealth of Puerto Rico, of the 18, 13 of them will come in this year for their renewals. Of course the budget will not change remarkably, so they replace the existing grants. In addition to the base support which as you know is in the range of a million and a half dollars per State, we would also extend to the States through a very limited fund, to selective States, the opportunity to more rapidly develop their science and technology infrastructure.

Let me give an example. In a State that has over the years of EPSCoR carved out a niche, say, in materials as a research area, they can, beyond the $1.5 million, get a modest amount to actually advance that. With level funding, we have enough money to fund all of the programs, renew all of the grants and have the small special fund to which I referred. So $31.9 million will do it.

MATCHING REQUIREMENT FOR EPSCOR

Mr. MOLLOHAN. I think that there are a couple of problems that are systemic to and counterproductive to fulfill the goals of EPSCoR. Do you agree?

For example, let me ask you most specifically about the matching requirement for EPSCoR. It is particularly difficult for them to come up with this matching. Is this an issue that resonates with you?

Dr. LANE. Well, it does, but it is—Mr. Mollohan, it is a larger issue than just EPSCoR, because as we know, as you know, we have matching requirements in many of our programs.

Mr. MOLLOHAN. Right.

Dr. LANE. But the matching does more than sort of stretch the funds, although that is important for the effectiveness of the program. It also shows a commitment on the part of those folks who are providing the matching. And my sense is with the EPSCoR program, probably as much as any other program I have much knowledge of, that firm, unwavering commitment is what makes it work on all sides. If it lets down one place or another in that partnership, the program is in jeopardy. And so——

EPSCOR MATCHING FUNDS

Mr. MOLLOHAN. So that demonstrates commitment as you look at it, and I would agree with that, up to the point of capability. Do you think there is a point at which their capability to participate because of their incapability to match becomes a problem?

Dr. LANE. I can't—I can't answer that from experience, Mr. Mollohan. If Dr. Williams has some information, it would be good to have it at this point.

Dr. WILLIAMS. Well, we are aware, the extended agreement and everything that Dr. Lane has indicated about the significance of the match, which, of course, you appreciate, it has to be a partnership. We operate under a cooperative agreement between the Foundation and the State.

Several States have indicated that it is difficult to achieve the entire $1.5 million. And what has happened, in individual cases, is what I would call a reason of rules sort of operation, where we were insensitive to the matching process for at least one of the five or six years.

Mr. MOLLOHAN. I am sorry, you were insensitive?

Dr. WILLIAMS. We were sensitive.

Mr. MOLLOHAN. Insensitive to the problem of making the match?

Dr. WILLIAMS. Right. So that the project is not jeopardized because they can achieve by typical means $1.3 million out of the $1.5 million. We talk about how we actually achieve the remaining $3 million. So it is a problem, but I think the leaders in the EPSCoR States would reiterate the significance of the matching arrangement.

Mr. MOLLOHAN. And I would reiterate it, too, that I agree with the importance of matching funds to demonstrate good faith. I would invite you to be sensitive to the fact that a threshold exists where it becomes so difficult to meet matching that a State, in fact, can deselect itself based on the matching issue.

Mr. THORNTON. Would the gentleman yield?

Mr. MOLLOHAN. I certainly will yield to my friend from Arkansas, after just one more point.

It becomes a greater problem as other agencies come on line with EPSCoR programs. As you well know, the purpose of EPSCOR is to grow research and development, which is a difficult process in the EPSCOR States, at least it is proving difficult in my State. As they overcome the many barriers that exist getting their programs on a positive track, then they start bumping up against this ability to match funding. As these other agencies come on line with EPSCoR programs, the problem magnifies and really does become an element that keeps people from participating in the program.

I will yield to my friend and then I will yield back to the Chairman.

EPSCOR STATE MATCHING FUNDS

Mr. THORNTON. If I may pursue that point, because I was alluding to that in my questions when Mr. Lewis yielded to me. It seems to me that there is a remarkable situation when 18 States are willing to match dollar-for-dollar funds from the National Science Foundation to develop the capability of doing research. These States are not asking questions about indirect costs. They are putting up dollars, because they want to get into this area. I wonder if there is a dichotomy there that should be looked at.

Dr. LANE. Well, we are certainly sensitive to the issue, and as we are to all matching arrangements. I think we don't want to have programs—we would not want to find that our programs were less effective than they ought to be because of constraints that we have control over. So we are very sensitive to the issue.

Mr. THORNTON. The entire EPSCoR program could be funded out of the matching funds for one research institution. Is that not correct?

Dr. LANE. Let's see, which one did you have in mind, Mr. Thornton?

Mr. THORNTON. Well, no, I am not suggesting any particular one. There is a list of about six or seven.

Dr. LANE. I understand.

Mr. THORNTON. Each of which receives more money in matching funds than the entire cost of the EPSCoR program. Is that not correct?

Dr. LANE. It is. I believe the EPSCoR program is a very highly leveraged program in its effectiveness for the dollars.

INDIRECT COSTS

Mr. MOLLOHAN. Thank you, Mr. Chairman. I would like to go on record with my concern about how the Administration's indirect cost "pause" proposal could also have a dampening effect in EPSCOR States. If we are frozen at current rates, then we add another disadvantage to the equation of improving Research-Development in EPSCOR States.

Mr. STOKES. We will come back to you.

Mr. Torres.

ADVANCED TECHNOLOGY EDUCATION

Mr. TORRES. Thank you, Mr. Chairman. Good morning, Dr. Lane, Dr. Duderstadt. I want to thank you for your excellent testimony this morning. I want to thank you also for the help that NSF gave California during our recent earthquake. I think the damage would have been much worse had NSF not participated in the retrofitting of bridges, 200 of them, I recall, in California, that came under your Earthquake Hazard Mitigation Program, and to that degree I am most appreciative.

I would like to talk about some of the items here in your testimony. Last year Congress appropriated $15 million in start-up funding for the new community colleges grants. And I would like to ask at this time, how have the colleges responded to this level of funding in their area?

Dr. LANE. I would like to ask Dr. Williams to respond to that, if I might, Mr. Torres.

Mr. TORRES. He was here last year. We talked about this.

Dr. Williams.

Dr. WILLIAMS. Mr. Torres, the impact program, as you know, is the Advanced Technological Education Program. After receiving the funds, we developed the program last year, just focused in two areas, individual projects, which will go to individual community colleges coupled with secondary schools and local industries, or the other mode of support, national centers. We wanted to develop resource centers, clearinghouses that would, for example, serve a collection of such institutions in the upper Midwest or California or Texas.

In response to the regular proposal, we received 317 preliminary proposals from the broad community. And for the centers planning grants, 33. We are in the process of making the first round of awards out of that competition.

Mr. TORRES. How many of those will be funded?

Dr. WILLIAMS. We anticipate making planning grants up to six centers, and probably something on the order of 40 individual awards.

Mr. TORRES. And that would be the totality of awards for—

Dr. WILLIAMS. For 1994.

Mr. TORRES. For 1994?

Dr. WILLIAMS. Right.

Mr. TORRES. This year NSF has requested $17.6 million for the advanced technology education, which provides the support for community colleges. Those are the numbers that you just gave me that will be funded?

Dr. WILLIAMS. No, the funding I just cited will be out of 1994, which is roughly $15 million. It increases by $3 million in 1995.

Mr. TORRES. Three?

Dr. WILLIAMS. Right, to $17.6 million.

Mr. TORRES. Would you agree that there is sufficient need and interest in these science and advanced technology grants to justify what I understand to be the full authorization level of $35 million?

Dr. WILLIAMS. As reflected by the proposals we received.

AWARD SIZE

Mr. TORRES. You would agree that that would be sufficient? Last year, Dr. Massey testified that it was a high priority for the Foundation to increase the size of individual investigator grants in order to fully fund research projects. Do you recall that? You weren't here, Dr. Lane. But maybe you will want to refer that question. Has there been any progress towards this goal?

Dr. LANE. Well, Mr. Torres, it is still a goal to increase the average size of grants in many areas. The portfolio of the projects NSF supports is really very broad, so there are some very large grants and there are some very small grants. And so it will not—the strategy will not be the same in every particular part of the Foundation. But we do project that the average grant size will go up in 1995 with the request, with the 6 percent.

We expect that the average annualized award size will go up from 55.5 to 59.5; that is, $55,500 to $59,500. Or the median—I am sorry, that is the median. The average award size goes up from $80,000 to $84,500. So the whole distribution shifts.

Mr. TORRES. How does that compare with last year's figures?

Dr. LANE. With last year, in 1993 the median annualized award size was $51,600. And so we are going from $51,600 to $55,500 this year, to $59,500 next year.

AWARDS TO LOCAL SCHOOL DISTRICTS

Mr. TORRES. At last year's hearing, I remarked that local school districts receive relatively few awards in comparison with institutions of higher learning. Has there been any increase in the funding of local school districts?

Dr. LANE. Well, I believe, Mr. Torres, that the numbers are up, but I would like to ask Dr. Williams.

Dr. WILLIAMS. The numbers have changed, sir, because of the different—the set of new programs that we have. For example, the Urban Systemic Initiative requires that the leadership of the school system be the principal investigator, the superintendent, and we are working in, as you know, 25 of those cities, plus the District of Columbia, so 26.

The Rural Systemic Initiative obviously involves the leadership from the school districts, but in addition to that, benefitting from five or six years of operation where typically colleges and universities received the grants and ran teacher training programs on behalf of the teachers drawn from the district, the school districts have developed some capabilities themselves. That is, they have developed lead teachers. And an increased number of those are actually making successful application to the Foundation. So the ratio has changed.

Mr. TORRES. Let's be more focused on this. I want to speak specifically to my area, Los Angeles. How much has been funded in that area for the area of science and math and teacher training in those public schools?

Dr. WILLIAMS. We would have to provide it for the record.

Mr. TORRES. Would you do that? I would be very interested in knowing those numbers.

Dr. WILLIAMS. We will.

[The information follows:]

LOS ANGELES FUNDING

NSF funding in the Los Angeles metropolitan area for the combined fiscal years 1991, 1992, and 1993 totaled at least:

Teacher Training Projects, $16 million;

Total Science and Math Education in the EHR Directorate, $56 million.

MINORITY PROGRAMS

Mr. TORRES. Dr. Lane, I took note during your testimony about the recent progress on the Alliance for Minority Participation, and I must say your goals for the year 2000 are noteworthy, very ambitious to say the least. You cite anticipation of production of some 50,000 bachelor degrees by the year 2000.

This year NSF has requested a total of $3.2 billion, which, as we noted here, is an increase of $182.2 million over last year's funding. However, I notice that you did not request any increase of funding for the human resources development activity, which includes the following programs: Minority Summer Science Camps, Partnerships for Minority Student Achievement, Comprehensive Regional Centers for Minorities, Research Careers for Minority Scholars, Research Improvement in Minority Institutions, Minority Research Centers of Excellence and Minority Institutions for Excellence.

Do you feel that all of these programs are adequately funded for the fiscal year 1994?

Dr. LANE. Well, we plan five additional awards in 1994.

Mr. TORRES. Would you repeat that?

Dr. LANE. We plan five additional awards for 1994, and that will bring the total, I believe, up to 20. In the AMP program specifically, these projects will enroll more than 75,000 students. And so we still feel that our goals, while ambitious, are realizable under these scenarios.

Do you want to add something, Dr. Williams?

Dr. WILLIAMS. There is one other factor that should be emphasized. Prior to the advent of the Urban Systemic Initiative in the K to 12 sector, we were attempting to address the broad needs of minority students in math and science education through three of the programs to which you referred: Summer Science Camps, the comprehensive Regional Centers for Minorities, the district level program called the partnerships.

With the advent of the Urban Systemic Initiative, which is multimillion dollar, and will engage all of the schools in the city in those 25 cities, if our funding plans are achieved, that is in response to the proposals, it would afford some flexibility within the budget in these areas. For example, a comprehensive regional center that is operated quite well in Chicago. Chicago is eligible for an Urban Systemic Initiative. If it receives one, then we are going to operate these two programs synergistically; that is, they will be made one whole. Therefore it spares resources that can be used in others of the programs to which you refer.

So while there is no budget increase, we have an overall funding strategy to achieve what we desire in the Urban Systemic Initiative Program, we clearly expect to. There will actually be net resources as an internal rebudgeting exercise. So, yes, the numbers don't increase as the request, but that really doesn't matter with what, in fact, we will be able to do.

Mr. TORRES. Thank you for your answer. Let me just raise one more question, my final question. I note that the Office of Science and Technology Policy, the Director, Mr. Gibbons, is he here?

Dr. LANE. He is not here today.

UNESCO

Mr. TORRES. Well, I was going to raise a question. The office provides advice and recommendations to the President on the utilization of science and technology in addressing important national problems, one of which is obviously the coordination of implementation of a number of important international science and technology agreements that we have worldwide. And I note the mission of the office speaks to working with—through the State Department with various nations of the world.

In that the director makes recommendations to the President of the United States, has there been any discussion about recommending to the White House that we reaffiliate to the United Nations Educational, Scientific and Cultural Organization?

Dr. LANE. Well, I am not aware of the recommendation the National Science Foundation might have made prior to my arrival, so I guess my colleagues are saying, no. But maybe we could get some help from one of my assistant directors on that, who has some information.

Dr. CORELL. Last spring, the President issued what is called Presidential Review Order 12, within which there was a request on an interagency basis coordinated under the State Department to review a number of our international arrangements, among which was a review of our position with respect to rejoining UNESCO.

It is my understanding that the task group is still working on that, and there has been an extensive effort on the part of the Interagency Committee, chaired by the Assistant Secretary for Oceans, Environment and International Science, and that we should hear more on that in the near future. But I do not believe that has been completed.

Mr. TORRES. Well, I happen to know that the task force has finished its report and it is already at the White House. And I am just wondering whether the office that I am citing of science and technology has had a chance to review this policy.

Dr. LANE. It is probably not appropriate for me to—I don't know the answer, Mr. Torres, anyway, but it looks like a question for Dr. Gibbons.

Mr. TORRES. Dr. Gibbons is one of the staff—one of the directors that works under the aegis of NSF, right?

Dr. LANE. No, he really is the President's science adviser and director of the Office of Science and Technology Policy and reports to the President.

Mr. TORRES. Oh, okay, all right. Well, then I will have to communicate with him directly on this question.

Thank you very much. Mr. Chairman, I yield back any time that I may have.

Mr. STOKES. All right, Mr. Torres.

Mr. Thornton.

EPSCOR FUNDING IN ARKANSAS

Mr. THORNTON. Thank you very much, Mr. Chairman. I also would like to thank the gentlemen from California and West Virginia for yielding, as I had opportunity to hopefully add to the line of questioning in which they were engaged.

I was pleased to see in the March 4, 1994, issue of Science Magazine, a featured article about the EPSCoR Program. It begins by discussing how in 1977 Richard Atkinson, who was then Director of NSF, was caught off guard when a Congressman from Arkansas tossed him a curve.

Dr. Atkinson was asked how much research did NSF fund in Arkansas. Dr. Atkinson said that he wasn't sure, but he thought that it wasn't very much. I told him that I didn't want a handout, but I did want NSF to realize that discoveries could happen anywhere in the country. In order to make discoveries, Arkansas scientists had to improve their ability to compete for grants. I was so pleased that Dick Atkinson was an inventive man who realized that it was not just in the big laboratories that inventions could occur. As Chairman of the House Science Research and Technology Subcommittee, I was happy to work with him and Jack Talmadge, Joe Danek and others in developing the idea that science could occur anywhere and recognizing that one of the problems to be tackled was educating scientists how to best disclose that they had an idea that ought to be pursued.

In my own State of Arkansas, during the next year, 1980, there were 18 peer-reviewed grants to scientists. Last year, there were 876—50 times that amount. And these grants were not only for the programs that stemmed from EPSCoR; the side effect has been tremendous in EPSCoR States.

For instance, at the University of Arkansas, completely with our own funding and with no Federal money attached, we hired Dr. Allan Herman and Dr. Sheng as creative researchers and inventors. They came up with the world's highest temperature superconducting material, a thallium-based compound that still shares the world record for superconducting materials operating in the liquid nitrogen regime.

I am glad, in a way, that we didn't have Federal funding on that, because we patented it and we have received a good return at UA on that invention. But the point of my concern is whether NSF continues to thoroughly evaluate possibilities of improving America's science and technology base. And here I want to pick up a line of questioning initiated by the gentleman from California, Mr. Lewis, and take it in a different direction.

EPSCoR gets 1 percent of the NSF budget. K through 12 education gets 10 percent—about $32 million for NSF and $360 million for K through 12. My concern is whether this funding level recognizes America's need to stimulate young people to enter into scientific inquiry and to consider the possibility that this might be a suitable career at the time that those decisions are being made.

Let me ask, do you find many people who get to college and then say, hey, I want to be a scientist? Or is that decision made sometime before college?

Dr. LANE. Not many, Mr. Thornton. I mean that is a problem we have in our universities and colleges, perhaps with our teaching of science, in that I think those who go on in science, mathematics, engineering, generally have made that decision or at least that strong inclination before they get to the university.

ENGINEERING POSTDOCTORIAL STUDENTS

Mr. THORNTON. I believe more than half of the post-docs in engineering are not American citizens, nationwide. Is that not correct?

Dr. LANE. It is a large percentage. Dr. Williams, is half the right number? Yes.

BROADENING EXPOSURE TO SCIENCE

Mr. THORNTON. And the teaching faculty itself is increasingly being made up of people who have immigrated to this country, maybe have attained citizenship, but did not get the stimulus for entering science from the programs in this country.

What I really wonder is whether we are spending enough at the K through 12 level to seize opportunities to demonstrate to communities the extraordinary value of science education and technology. Do you have any comment on that?

Dr. LANE. Well, Mr. Thornton, I feel—maybe I could comment about the EPSCoR program first, and then come back to this, if I could. I was privileged to serve under Dick Atkinson the one year that I did spend at the NSF. Dick Atkinson was the Director and George Pimentel was the Deputy Director. It was really a wonderful time. I have to confess, I was coming from the university, I was skeptical about this EPSCoR program when I first heard about it. Didn't sound right to me somehow. And I didn't learn much about it at that time. But then I went back to the university and was invited some years later to serve on a review team, make site visits for one or another EPSCoR State.

Alabama I visited, Wyoming I visited, and then more recently I had the pleasure to go to the annual meeting of the EPSCoR programs. And that was a terrific experience. But I saw in that first encounter what a relatively modest investment can really do. I was really turned around in my first interaction with the EPSCoR people. It is also impressive that the people who involve themselves in those programs and, therefore make them successful, are champions and also heroes and heroines, if you like. They really put their energy and effort into it. They are believers. And I think without that, it just isn't going to work.

That is a very important program, in my view, and will remain so. On the why is it so important, because I agree with you, the bright people are everywhere. And young people grow up, bright young people grow up everywhere. You don't know where they are going to be.

If you believe that they can get a fine science, mathematics education, without any exposure to research or without having in the classroom, faculty who do research and who are themselves caught up in the excitement, stimulation of discovering, then you don't need EPSCoR. I mean you have some other kind of program. But we don't believe that; I don't believe that.

I believe that you do have to have in the classroom those kind of faculty and that you do need to expose young people to the excitement of discovery. Because even if they don't become scientists, mathematicians and engineers, but we would like more of them to do that, even if they don't, it is so important to their own education. It opens up career opportunities for them by having that kind of sound basis and that understanding of what it is all about that otherwise they don't have. So there are strong arguments, I believe, compelling ones, to be made for being sure that we have all over America those opportunities for the young people who are growing up there.

Now, what should be the right investment? I think, of course, we are evaluating all our programs now in education, human resources, and we want to find out what works and what doesn't work. We could—we could spend twice as much money as we are spending or three times as much money and not do any more if we don't have the right programs. And we think we do. Already what we know tells us——

Mr. THORNTON. If I may interrupt, I think you have some excellent programs. I am really pleased with many of them. Please continue.

Dr. LANE. We will look, we will evaluate these programs and we will look carefully.

ENCOURAGING STUDENTS TO ENTER SCIENCE

Mr. THORNTON. I hope that you don't bar the door to acts of creativity occurring as you attempt to discover what does work best.

Dr. LANE. Absolutely.

EPSCOR INTERAGENCY COORDINATION

Mr. THORNTON. I was real pleased with Dr. Atkinson's not putting barriers in the way. And like you, I was a little concerned about how EPSCoR would do, but I have been very gratified. It is a multi-agency enterprise now and you all have been given the coordinating authority for that.

Is that not correct, sir?

Dr. LANE. That is correct.

Mr. THORNTON. And how is that proceeding? Are you able to have meetings of the appropriate committee?

Dr. WILLIAMS. Yes. Congressman Thornton, as reflected in the report to the Congress, we have established, last year, an interagency coordinating committee for EPSCoR that is Chaired by Joe Danek in this effort. And all of the agencies that have EPSCoR and EPSCoR-like programs participate.

We formulated a set of operating conditions under which we could collaborate, share resources, change program announcements, et cetera, to try to operate as a Federal enterprise. And six agencies signed a memorandum of agreement. For different reasons, DOD and NIH did not sign it. However, they participate in all of the meetings. Those two agencies' EPSCoR-like programs are most unlike the others. That is not the only reason they didn't sign the memorandum of agreement.

The second charge, which came from the appropriation language last year—I am sorry, for fiscal year 1994, is that we should move to the next level and try to assist the States in doing the same sort of collaboration, how to deal with five agencies. We have essentially done that State by State, each of which has typically subordinated the programs of the other agencies to the existing NSF statewide structure. So it is working reasonably well.

K–12 SCIENCE PIPELINE

Mr. THORNTON. Dr. Williams, I would like to ask you to comment, because it does lie in your area, if that is all right with Dr. Lane, about the pipeline for developing science and scientists capable of doing world class research. NSF has done a good job, I think, of trying to develop a pipeline for that, by applying resources at the start of the educational pipeline and trying to draw more young people through it.

Do you think that the programs in K through 12 education are providing an impetus, a real push to encourage bright young people—especially disadvantaged youth who might not even consider that they could have an opportunity to be a scientist or even to go to college—to expand their horizons and to enter that educational pipeline with a surge of dynamic self-esteem that the EPSCoR professors seem to have demonstrated?

Dr. WILLIAMS. Well, I would submit, Mr. Thornton, that our program, the programs we developed in the last year or so are exactly of that iteration. I spoke earlier about, you know, we have had for now three years the Statewide Systemic Initiatives. And clearly that accommodates a group of students who heretofore were neither afforded the opportunity to seriously study science or math or even thought it was realistic.

We then moved to the next level and decided to target the largest American cities in terms of population, in terms of the numbers of students who live in poverty. And these are defined by their being eligible for food subsidies, lunch subsidies. This, again, is a very large population that does not nearly contribute its annual issuance of youngsters who are seriously interested in math and science.

The later iteration of these programs is the Rural Systemic Initiative, which is intended to address the needs of students, who I would submit without apology, basically haven't received serious attention for education of any sort, forget about the math and science. So we are doing precisely what you are making reference to.

A statement that has bearing on the 360 million dollars, leaving aside the question of the amount, I would argue that the Foundation has displayed it in a fashion that it encompasses the whole enterprise. All of the reasonable things we are doing in that sector, I think the Foundation has a program that is addressing those various components.

Mr. THORNTON. And you don't feel any constraints against——

Dr. WILLIAMS. No, no, very much not.

Mr. THORNTON [continuing]. Moving in that direction? I am real pleased to hear that.

I want to bring up one line of questioning, if I may, Mr. Chairman. I may be running a little long on my time, but it will just take a couple minutes.

Mr. STOKES. Please take the time you want.

INVESTMENT IN SCIENCE

Mr. THORNTON. Thank you very much, Mr. Chairman. I am concerned that Dr. Duderstadt may have felt that I was opposed to the great investment that is made in science at great research institutions. I do support that. Now, I am going to try to get some support from Dr. Duderstadt on an idea that I have been developing. I am the author of a bill, H.R. 484, which provides for capital budgeting that makes a distinction between current expenditures and investments in the future.

My bill classifies as capital investment not only traditional infrastructure needs, but also investments in research and development and other areas where it can be demonstrated that there is a return to the Nation from monies expended. For instance, this was done on the GI Bill, where we learned that we got $5 back for every dollar that was spent to educate returning soldiers after World War II. What do you think about that idea? Should we not distinguish between capital investments and expenditures for salaries or one-time operating expenses?

Dr. DUDERSTADT. Well, certainly the intellectual infrastructure of the country and the investment in it is of enormous importance at a time when our society is driven by knowledge itself. I think as kind of a tangential comment to the line of questioning you had earlier, part of the difficulty our Nation has faced is since the time of the GI Bill and programs of the National Defense Act, we have not had a driving Federal policy for human resource development that paralleled similar policies for research. And therefore we allowed in many cases research policy to dictate how we produce people.

And I personally believe that the most valuable resources of this Nation are its people. And therefore investment in that, which can be looked upon as I think having the highest rate of return of any conceivable investment society could make, it is quite appropriate for that to be part of a broad national policy. It is the most critical part of our infrastructure.

Mr. THORNTON. I appreciate that, because I share that view. It seems to me that we need to at least know the difference between the dollars that are being spent for operating expenses and those that buy something on which we earn a return. This issue got twisted up in the debate over a constitutional amendment to balance the budget recently, but I think it stands quite apart from that debate.

I think that we need to make judgments and priorities based upon a clearer understanding of what we are buying with the dollar that is expended.

Dr. DUDERSTADT. And to look upon that as an investment.

Mr. THORNTON. And to look upon some items as an investment. Do you agree with that?

Dr. DUDERSTADT. I think that is right.

Mr. THORNTON. Mr. Chairman, that concludes my line of questioning.

EHR INCREASE

Mr. STOKES. Okay, Mr. Thornton. Very good.

Dr. Lane, let's go back to the education and human resources area for a few more questions. Although your request for education and human resources increases by 3 percent, this is significantly less than last year's requested increase of more than 14 percent. Tell us why this particular activity only receives a requested increase of 3 percent, when the overall agency increase is 6 percent.

Dr. LANE. Well, Mr. Chairman, I am not sure what I can add to my earlier comments, except to say that we did make some very hard decisions and some very tough choices among many high priorities. And there is no question, but education, human resources development, is a very high priority at the NSF, as are a number of our programs.

In order for us with a 6 percent budget to make the substantial investments in the strategic areas, the particular strategic areas that I referred to earlier, it was not possible to make similar increases in other areas. This also being a year of comprehensive evaluation of many of our most important programs, it seems to be a good time for us to focus on those evaluations. And we are investing, not large amounts of money, but the appropriate amounts of money to ensure that these evaluations are carried out.

Could I ask Dr. Williams to add to that, if he has something that can help you?

Mr. STOKES. Well, he can, but I guess the concern of this subcommittee would be that in light of NSF's intent to leverage major changes on the States in terms of math and science, aren't you limiting your own goals by not proportionately increasing funding support in this area of the budget?

Dr. WILLIAMS. Well, the increase is small, admittedly, compared to last year. And, of course, in last year's request with two very large new grants, Advanced Technological Education program for which we sought $15 million, and the Urban Systemic Initiative, that is the first full year funding of it and we were seeking about $15 million there.

The second question is with the small amount, how it is actually used. And it is applied to the three highest priorities, the Urban Systemic Initiative, which allows us to increase it to about 20—if it is granted, to about $25 million, keep the momentum there. The second is to more than double the budget for the Rural Systemic Initiative, even though I admit it is small. It is going from one to two-and-a-half million dollars, but it keeps the trajectory right. And it adds $2 million to the Advanced Technological Education Program.

For our current agenda, in my view, we can do most of the things by priority that we have in our portfolio, most of the things meaning most of the programs, but in a highly prioritized manner. I can keep the momentum going on the highest priorities.

SYSTEMIC REFORM

Mr. STOKES. Well, both of you have mentioned systemic reform. And in your justification you tell us that the largest percentage increase was within the education and human resources activity; you are talking about 7.3 percent above last year's level. Tell us why you have chosen to increase this area higher than any other area.

Dr. WILLIAMS. Well, at the moment, within our current planning, the Urban Systemic Initiative is the highest priority. I indicated the significant funding base to start the program last year. We are in the process of reviewing proposals from 11 of the 25 cities. We are clearly going to have proposals from all of them by July, and that is the priority, but also that is the area where we commit significant resources.

The rural program is just being planned, and we very much want it to be initiated, thus the other $2 million. So that $8 million out of the total request is entirely consistent with the two highest priorities, and that is why the request is made that way. As I said earlier, these two areas, urban and rural, are the areas in which we decided we should give preferential attention in the near term.

Mr. STOKES. Well, let me follow-up on that. You are talking about urban, rural and State. And in the past, the subcommittee has been a strong supporter of the statewide activities. Can you tell us why there has been no funding increase in that area?

Dr. WILLIAMS. Well, we made a decision, as you remember, Mr. Chairman, that we would start this program which would obviously be a high risk venture for NSF, try to engage the entire State in reforming math and science education, but the pool would be half of the country, so in effect 25 programs. We have 26. The oldest programs are in their third year.

We just completed the midterm review of the first ten of those programs, and the idea was to maintain that, but actually not grow it until we had the benefit of more detailed analysis, and, in fact, there is an evaluation underway. So we are on target in terms of the Statewide Systemic Initiatives, and the question about whether it would be extended to other States is certainly several fiscal years out. We want to operate the program until we are convinced that it is netting the result that we intend.

URBAN SYSTEMIC INITIATIVE

Mr. STOKES. We were pleased to see that you increased the Urban Systemic Initiative by $6 million. And, of course, your justification indicates that these additional funds will allow NSF to fund some of the eligible cities at a slightly higher amount. Tell us why the Foundation has chosen to increase the amount per city rather than to increase the number of eligible cities?

Dr. WILLIAMS. Well, actually, the language aside, in reality we will probably do both. We are increasing the amount because this is an initial five-year award. The first year of the award we provide $2 million, which is the smallest of the amount that it can receive, so the remaining four years, they can receive $3.25 million. So the money is funded delta between 2 and 3.

Now, it depends on the quality of the proposals and the outcome from the merit review process. If, in fact, we have a larger number of highly meritorious proposals, then we will use the additional funds. In addition, we will use the monies to increase the number. Our target at the moment, we have a three-year plan to fund the 25 cities, so basically the idea, if the proposals merit it, we would fund seven cities per year. Obviously, if this year, where I think we have had an excellent outcome for providing each of the 25 cities planning grants, they have all done an excellent job, it is very probable that we will have an increased number to fund even in the first year. That is what we will do.

Mr. STOKES. What is your criteria for selection of the cities?

Dr. WILLIAMS. Well, we selected the cities based on population, student population, and adjusted those numbers to give some index of poverty. And for that we used the poverty of education statistics in terms of eligibility for free lunch. So the idea was to have an urban program and have it focused in the area where we have the largest impact and where, in fact, the students were in the greatest need. And from my interaction with the cities, these certainly were the areas in which to concentrate.

RURAL SYSTEMIC INITIATIVE

Mr. STOKES. Now, your rural program is a new program. Have you made any grants yet?

Dr. WILLIAMS. No, we are just involved in planning, consulting with the rural communities. We will make a few planning grants this year, in fiscal year 1994, that they will then use, as the cities have done this year, to translate them into implementation proposals next year.

Mr. STOKES. When do you expect your first award to be made?

Dr. WILLIAMS. In the rural? In the summer, July time frame.

Mr. STOKES. How many rural areas will be funded with the $1,500,000 provided in fiscal year 1994?

Dr. WILLIAMS. The majority of that is going to be used for planning grants, so with them averaging maybe $50,000 to $70,000, planning and development grants, six or seven, six or seven, something like that.

Mr. STOKES. Have you established any criteria in terms of the rural grants?

Dr. WILLIAMS. Yes, we, in fact, have just finalized the development of the program announcement. It has been approved by OMB. It is an analog to the requirements for the urban, and basically what they are required to do is to agree on a very explicit set of math and science education goals for the students; that is, eliminate or narrow tracking, provide a challenging curriculum to all of the students, and have ways to actually assess it and make sure the teachers in math and science actually have the competence to provide the courses.

RURAL, URBAN AND STATE INITIATIVES

Mr. STOKES. Dr. Williams, do you see this rural program as in any way complementing the urban or statewide program?

Dr. WILLIAMS. Yes, yes, very much so.

Mr. STOKES. In what respect?

Dr. WILLIAMS. Well, we think of it as a trilogy. In an ideal world, we would only have to have the Statewide Systemic Initiative, because it would effectively address large cities and the rural components. In reality, that doesn't happen. What has taken place in the States is they are working in the domains other than these two extremes, three extremes in terms of need. So the idea is to acknowledge the fact that in State X you are not oversampling for these populations of students who have enormous needs in rural areas and in cities. So create the other two components to deliberately address them, so that is what we are doing in the 25 largest cities and in the rural areas.

So imagine that the three programs are operated over time in concert. After a finite period of time, we should actually have mounted a nationwide effort that actually has benefited the most—the majority of the students—not limited by geography and economic circumstance and a variety of other indices. That shouldn't matter.

Mr. STOKES. Mr. Lewis, anything further before we break for lunch?

AIR QUALITY RESEARCH

Mr. LEWIS. Mr. Chairman, I just wanted to mention to my colleague, Esteban Torres, that when I had to leave a moment ago, it was to meet with one of my colleges, a university in the region, and it came to my attention that a pretty significant piece of the research dollar available for air quality matters is in some way finding its way to Texas.

It strikes me that you and I should address that question with some seriousness.

Mr. TORRES. We have a bigger problem, right?

Mr. LEWIS. I think the research ought to be done someplace close to Los Angeles, I think.

SUPPORT TO TWO YEAR COLLEGES

Mr. Chairman, if you want me to drop by Cleveland, let me know. I did want to just raise a point regarding the advanced technology education effort and community colleges. If one of my local community colleges, San Bernardino Valley College, is an illustration, I think there is tremendous potential for programmatic effort at that level.

I noticed for some years that the two-year community college has an amazing ability for attracting young people from local high schools who didn't quite make it there, went away to the service and came back. And any number, after two and a maximum of three years, go directly to USC dental school.

I mean there is something going on in that math and science program that is pretty phenomenal. And I certainly hope to have them address the questions of funding that might be available that would help with that. The community college generally is of great interest. Thank you, Mr. Chairman.

Mr. STOKES. Sure. Mr. Torres, anything further?

Mr. TORRES. Nothing further, Mr. Chairman.

Mr. STOKES. Okay, I think this might be a good point for us to recess for the noon hour. And then we will resume at 2 o'clock this afternoon. Thank you.

REDUCTION IN MINORITY PROGRAMS

Mr. STOKES. The Committee will come to order.

We will go back to the same section that we were in previously to start our questions this afternoon. The undergraduate student support subactivity is requested at $25,510,000 for fiscal year 1995. This is about half a million dollars less than requested by NSF in fiscal year 1994.

According to your justification, the major components of the subactivity are Research Careers for Minority Scholars and Alliances for Minority Participation. But we note that this level requested includes no increase, and is actually $500,000 less than the fiscal year 1994 request, and of all the subactivities under Human Resources Development, this is the only one to receive a reduction.

Can you tell us why you have chosen to reduce this particular subactivity?

Dr. LANE. Dr. Williams, you want to comment on that one?

Dr. WILLIAMS. Yes. You are correct, there are two programs here. The Alliances for Minority Participation, which will increase by five programs this year, from 15 to 20, and this $19 million. The Research Careers for Minority Scholars is the smaller of the two. Of the total amount for undergraduates, the largest component is the AMP Program, the Alliances for Minorities Participation, which is at $19 million, but in the end of 1994 will be supporting 20 such programs.

The smaller of the two is the Research Careers for Minority Scholars, that is the individual program and after doing renewals in 1994, it is short $500,000. So that is the reduction.

Mr. STOKES. But I think our question was, Dr. Williams, why you have chosen to reduce this particular subactivity, since it is the only one that received a reduction.

Dr. WILLIAMS. Right. And the point I was making is that the reduction is $500,000. And that results primarily because of the renewals that we are going to make in 1994. I understand the point, but what I am trying to convey is that it is small relative to the total.

ALLIANCES FOR MINORITY PARTICIPATION

Mr. STOKES. Both you and Dr. Lane have mentioned in your statements the payoff from NSF support for the Alliances for Minority Participation, AMP program. And it has been discussed here rather extensively. Tell us a little bit more about this program.

Dr. WILLIAMS. The Alliances for Minority Participation program was started in 1991. The intent was to employ an institutional strategy to try and address the difficult problem of the number of minorities receiving bachelor's degrees in science and engineering.

As was indicated this morning, before the advent of this program the whole country was producing about 14,000 bachelor's degrees per year, all of science and engineering. We thought the way not to accomplish it was to give a host of grants, small grants, but rather to see if we could entice a whole State, higher education system, to take up the problem. So we created the alliances. And they are essentially statewide ventures.

For example, we have a program in the State of Alabama, one of the most successful ones, which includes all of the HBCUs in that State plus the two major State universities. Same thing in Mississippi. In this area, we have a consortium that involves Howard, Morgan State, University of the District of Columbia, Hampton, so forth. And they are tasked to start with their baseline level of production and minimally over five years double it. So if you aggregate the number, say the base is a couple thousand, then they are asked to double that number.

The activities that are supported under it have to do a very substantial recruitment effort, because we are talking about an increase in numbers. And those newly admitted students are then the subject of a series of efforts that have been shown to be highly efficacious. They engage in group study, they have tutorials available, they have research experiences during the summer, they are assigned mentors, faculty mentors. So those are the common elements of the program. And in the 15 that exist now around the country, even prior to the five years, remember, the oldest program is only in its third year.

By any definition they are doing a remarkable job. In fact, they have already produced in excess of 1,500 students net increase, better than 1,500 students.

Mr. STOKES. In the three-year period?

Dr. WILLIAMS. In the three-year period.

When looked at in one context per the cooperative agreement we have with these organizations, we don't really expect the production until four years out. And they are—the degree of production that is currently underway will allow the Foundation to achieve the goal that we have tasked these alliances to address.

The program obviously has done something else. I would argue that it is equally important. It has clearly changed the cooperation, the correlation between these various institutions in States. For example, in the State of Mississippi, the University of Mississippi, Mississippi State and Jackson State, all of the HBCUs are operating essentially as a consortium.

What they are discovering is that they can actually spare the scholarship funds to support students by pooling them and they are actually able to engage a larger faculty of students. Once we make the five awards that are scheduled for this year, the total number of students who will be under the rubric of the AMP Program, minority students, African–American, Hispanics and Native Americans, because we have two other programs sited in parts of the country to oversample for Native Americans, will exceed 75,000.

Mr. STOKES. Exceed 75,000?

Dr. WILLIAMS. Exceed 75,000 students.

NUMBER OF AMP AWARDS

Mr. STOKES. Now, according to last year's NSF justification, a total of 20 Alliances for Minority Participation awards will be made. Now, the new budget justification states that the fiscal year 1995 request will provide continuing support for 15 existing projects and the initiation of some new starts. How many awards were made or will be made in fiscal year 1994?

Dr. WILLIAMS. Five.

Mr. STOKES. Okay.

Dr. WILLIAMS. To make 20.

Mr. STOKES. Okay. So the number has not changed, it is still 20?

Dr. WILLIAMS. That is right.

SIZE OF AMP AWARDS

Mr. STOKES. In fiscal year 1993, 15 awards were made with $12,800,000. Are the size of the awards increasing?

Dr. WILLIAMS. The size of the awards haven't increased. The size of the award is a million dollars a year, but we grant the awards to the institution. We also are funding a very comprehensive student database that operates in all of these programs, in every single institution. This tracking system obviously is the only reason I can give you the numbers that I have with respect to the number of students, their GPA, the academic performance and so forth. So on balance, it is a little better than a million dollars per AMP, because they have to pay the extra expenses for the student database.

AMP GOALS

Mr. STOKES. I notice that when AMP was designed it was to increase the number of minority students graduating with a bachelors in science, engineering and math to the total of about 50,000 by the year 2000. And of course you are telling us that 75,000 is——

Dr. WILLIAMS. The total number of students involved in the program right now—will be.

Mr. STOKES. So you have exceeded that goal?

Dr. WILLIAMS. If we had a 75 percent retention rate, or we could do less than a 75 percent retention rate and achieve it.

MINORITIES IN SCIENCE AND ENGINEERING

Mr. STOKES. Also last year, Dr. Williams, you told us that approximately 16,800 minorities would be receiving degrees in science, engineering and math. How many minorities would be receiving degrees in these areas this year?

Dr. WILLIAMS. Our estimate, which is in the documentation, is about 19,000.

AMP ACTIVITS TO RETAIN MINORITIES IN SCIENCE

Mr. STOKES. So you are over that goal also. In what ways is the NSF working with the alliances to ensure that we continue to attract and retain more minority students in the science fields?

Dr. WILLIAMS. What we are attempting to do, I alluded to that in part when I talked about this occurring in terms of the infrastructure and attitudes within the institution. An additional expense beyond the database is that we have created a network among the institutions. We have created, in effect, a steering committee that interacts with me. It includes the leadership of these institutions.

They are tasked to do three things. One, use increased amounts of their own funds, assist us in generating funds from other sectors. For example, in the various States the private sector is making contributions to the program, Coca–Cola, for example, in the instance of Alabama, three or four S&E industries in Arizona, California, so forth.

Third is that the associated institutions are experiencing the levels of success that heretofore was not the case in their own institutions, to try to entice them to, in effect, institutionalize these program elements that NSF's AMP Program has demonstrated are working. Otherwise, they are being successful, the institutions, in a fashion that they were not previously. They have been able to double the retention rate of the students, the notion being in outyears they need not have support by NSF in order to maintain that. That is the ultimate goal of the program.

If we can increase the production substantially to the 50,000 goal or even if it is less, and secondarily we then can entice the institutions to take up the agenda as a proposition of enlightened self-interest. That is the way to sustain it, and that has been going very well.

For example, we just received a letter from the Governor of the State of Alabama touting the AMP Program in that State, indicating that it is going to become an integral part of the State's allocation, at least to the State universities, colleges and universities in the State of Alabama, HBCUs and the University of Alabama. That is exactly the goal. That is the outcome we would like to occasion in every one of those States.

EFFECT OF SCIENCE EDUCATION ON UNEMPLOYMENT

Mr. STOKES. Let me just throw something at you that has been concerning me and my staff; something we have talked about. Does NSF either have the capacity to be able to do something about math and science as it relates to, say, those persons who are either not employed, never been employed, in some cases thought to be unemployable, but who in going into certain fields, if they were given the proper math, science background, might go into carpentry, air-conditioning, brick masonry, things of that sort? Anything available through the NSF of that sort?

Dr. WILLIAMS. Not at present. And the way our programs are structured, I don't think through NSF alone. But there are two considerations that might bear or are worth considering. As you know, NSF is one of several agencies who participate in the National Science and Technology Council, the interagency structure for education and training, emphasizing training because the Department of Labor is now a major player. It was not previously.

If you combine the programs operated by Labor, which fits the general interest you are describing, with the commitment by the Secretary of Labor that these programs, short-term job training efforts, substantially accommodate the math and science, unlike the case maybe even extending to today, with the fact that we have this Advanced Technological Education program, under which one actually can take individual courses, it seems to me there is a possibility of combining those two interests. That is, taking advantage of the fact that we have this program in community colleges that would be available to, as Mr. Lewis indicated this morning, to a variety of individuals who don't become full-time students. They take it almost in the cafeteria mode. They take the courses of interest to them. And they are not prototypically high school or college age. They take it as a function of need. And the fact that the Department of Labor would bring its program plans and its tradition, if you will, in terms of getting people into the work force, perhaps a partnership of sorts between those three players would be possible.

Mr. STOKES. I might submit for the record a couple more questions in that area, and ask you to expand upon them in the record for me.

Mr. DELAY. Mr. Chairman.

Mr. STOKES. Sure, Mr. DeLay.

DECLINATION OF YOUNG SCHOLARS PROPOSAL

Mr. DELAY. I have got a question that sort of fits in this area, particularly in encouraging minorities to go into these science and engineering fields. I am a little puzzled. Texas has what I think is an excellent program called TexPrep, or the Texas pre-freshman engineering program. This is a program that was first started in San Antonio in 1979. It has been replicated in ten other Texas cities. And it is currently being reviewed by many other cities around the country for implementation and has received nationwide recognition for its achievements in providing access for women and minorities to careers in science and engineering.

The program involves an eight-week mathematics-based enrichment program each summer. I would like to give you just a few statistics for the record on the participants and those success rates. Seventy-nine percent of the students are minority, 53 percent are women, and 50 percent come from low-income families. And based on the yearly TexPrep follow-up survey, the high school graduation rate is 100 percent. Ninety-two percent go to college or are college graduates, 58 percent of the college graduates are engineering or science majors, and 75 percent of the college graduates are minorities, and 70 percent of the engineering and science graduates are minorities.

However, in light of all this and NSF's outspoken commitment to devoting resources, as you just stated in answering the Chairman's questions for improving science, math and technology education programs in this country, and specifically targeting under-represented minorities, I have to tell you, I am really, really puzzled as to why the directors of these programs at NSF have denied the request for funding this year through the Young Scholars Fund.

Can you or, Dr. Williams, explain to me why they were turned down?

Dr. WILLIAMS. Well, I can explain to you in general terms why they were turned down. I am very familiar with the program. And my familiarity comes from knowing the principal investigator, but also the fact that we supported it for five years. So make that clear. The program has grown, as you indicated, substantially and the question became for us, when they submitted the next proposal which would be for the support six through nine years, is where should it be housed within NSF. It has to fit some program.

The program to which it was assigned for review was the Young Scholars Program. This is a program that is grade 7 through 12. It matches best with the students being impacted by Manuel and his colleagues in mathematics in San Antonio. The result of that review was not favorable. And one of the reasons is, very frankly, what he does in the program, doesn't exactly fit the Young Scholars Program.

The Young Scholars Program, you can take courses, very much like what they do here, but it is designed—it has a research component integral to the project. Basically, what young scholars means is high school students having an opportunity to get research experience before they go to college, on the assumption that that would increase their interest in being scientists and engineers. Then the program extended to, after that decision, negative decision, extended to the applicant the opportunity to apply under what we call special projects.

It simply means it doesn't fit any program. And, unfortunately, the result there was not sufficient to allow in terms of merit, to allow some funding. So that is the result.

DETAIL OF DECLINATION

Mr. DELAY. Well, frankly, I would like a little more detail as to merit. Because it is a successful program and has been for five years.

Dr. WILLIAMS. It has.

Mr. DELAY. I might be able to understand why it doesn't exactly fit the Young Scholars Program. However, the program officer of the Young Scholars Program suggested that TexPrep should be considered as an ongoing program funded by education and human resources. But there were several phone calls by the director of TexPrep to you, Dr. Williams, that went unreturned, and a few weeks ago the director was notified by NSF that no funding was available.

That doesn't exactly answer our concerns in Texas about exactly why this program, based upon the merits, cannot qualify for funding under education and human resources. And frankly, if the Young Scholarship Program recommended that TexPrep be made an ongoing program, why was the Office of Education and Human Resources so unhelpful in allowing this to happen?

Dr. WILLIAMS. You mean the Directorate of Human Resources?

Mr. DELAY. The education and human resources, yes.

Dr. WILLIAMS. That is the entire organization. Well, I think what I should do, first of all, is to have the staff provide you with the documentation of what, in fact, happened. I am sharing with you basically my briefing.

Mr. DELAY. Yes, I don't want to get into detail here. You can share it with my staff. But it is not just this Member, because I don't even think I even have this program in my district. If I do, I am unaware of it, but I do know there are ten cities in Texas that have it, and they are very concerned about it. Thank you, Mr. Chairman.

SUMMER SCIENCE CAMPS

Mr. STOKES. Sure. Well, Dr. Williams, perhaps you can have your staff meet with some of the staffs involved here and see if you can't resolve some of the questions. I think Mr. DeLay is absolutely right to bring up situations of this sort, and if we could address it in that manner, I would appreciate it.

Let me ask you now about the fact that for fiscal year 1995 NSF is requesting $5,510,000 for the Summer Science Camps Program. This program was started by the subcommittee a couple years ago. You recall last year the subcommittee increased this particular program by a million dollars above the budget request.

Can you give us an update on this program, Dr. Williams?

Dr. WILLIAMS. Yes, this is in fiscal year 1994, with the implementation of remedial measures to which you just referred to represent its third year of operation. The first year, we made—this is for focus on students ages seven to nine. We made 28 awards.

Last year, 1993, we made the 28 awards which supported 1,800 students. 1993, we made an additional 28 awards to make a total of 56. The number of students being supported is about 3,500. And this year, with a million dollars with awards ranging between $60 and $100,000 per year, we expect to make an additional 16 awards to bring the total to 70. So at the end of fiscal year 1994, we will have 70 programs supporting about 5,000 students, grades seven through nine.

Mr. STOKES. So this is a matter in which you utilize the additional million dollars?

Dr. WILLIAMS. That is right.

Mr. STOKES. The figure you gave us of 5,000, is that the number you expect to be involved this year?

Dr. WILLIAMS. At the end of 1994, that will have increased it from about 3,500 to 5,000.

MINORITY INSTITUTIONS FOR EXCELLENCE

Mr. STOKES. Good. Now, the Foundation is requesting $2,500,000 for the Minority Institutions for Excellence, which is intended to provide resources for minority institutions to increase retention and graduation in science, math and engineering. This is an agency-wide initiative; is that correct?

Dr. WILLIAMS. That is correct.

Mr. STOKES. I understand that all the directors contribute some resources along with the resources provided under the human resources directorate for this program. What is the total amount of funding devoted to this activity in 1994?

Dr. WILLIAMS. For 1994, the total amount would be slightly less than $2 million. The first stage in this program, which is fiscal year 1994, is to make awards of planning grants, comprehensive planning grants, from the very large pool of applicants, to 15 finalists for this program. They include eight Historically Black Colleges and Universities, five Hispanic-serving institutions and two institutions that focus on Native American students.

We have made four of the awards and the other 11 are in progress; that is, they are moving through the Foundation's grants process. Each of the institutions will spend six to eight months planning, doing comprehensive planning. This is a program, as you are aware, designed to improve the overall infrastructure of the institution. And in 1995 then, those 15 institutions, the outcome from the planning is a full-fledged implementation proposal that they will submit to the Foundation. And in 1995, we will then review those and make implementation awards.

Mr. STOKES. How much money is being requested agency-wide for fiscal year 1995?

Dr. WILLIAMS. Agency-wide, what has happened is that the amount—there is two-and-a-half million dollars in the education and human resources budget. The assistant directors, myself, make a recommendation to the director, who then decides the amount that is going to be contributed by the research directorates. So that hasn't happened yet, so I can't tell you beforehand.

MIE PROGRESS

Mr. STOKES. Now, I know this is a new program, but can you give us some idea what type of progress is being made?

Dr. WILLIAMS. It is going well. There is something else I should add, is that Dr. Bridgewater, who has responsibility for the program, at our urging sought to get other agencies to contribute to this program. And we have a draft memorandum of agreement that is soon to be signed between NSF, the Army Research Office, Department of Agriculture, Department of Energy, Department of Interior, and NASA, all of whom have agreed to join NSF in cofunding this program. So there will be a six-agency venture.

The amount of money, again, those agencies will bring to the process is not yet known, but I am very encouraged by the agreement of the leaderships of the agencies to sign the MOU, in which it stipulates that they have to contribute resources.

GRADUATE TRAINEESHIPS

Mr. STOKES. Also, this subcommittee has maintained an interest in the Graduate Traineeship Program. My understanding is that the budget does not include funding for any new awards, but rather funding for outyear commitments of the existing awards.

Dr. Lane, can you or someone tell us why this decision was made?

Dr. LANE. Well, I think this year in this request the decision was made to increase the value of the graduate fellowships. We have graduate fellowships that go to individual students, and they have the graduate traineeships that go to the institutions. And I think the increase has been made in fellowships this year.

Luther, can you add something to that?

Dr. WILLIAMS. That is the situation.

Mr. STOKES. Was the National Science Board consulted on this and did they agree?

Dr. LANE. The National Science Board certainly has been informed of the budget allocation. They know of the budget allocation. I am not aware they have any problem with it.

Dr. WILLIAMS. They are aware of it.

Mr. STOKES. They are aware of it, but they have not yet evidenced any concurrence in it, I would assume?

Dr. WILLIAMS. Well, or lack of concurrence.

Mr. STOKES. Or lack of, all right.

Dr. LANE. The best of my knowledge, they have not raised any objection over the decision.

Mr. STOKES. Okay. Mr. DeLay, any questions in this area before we move on to another area?

Mr. DELAY. It is under Dr. Williams' purview. I just have one more question.

Mr. STOKES. Sure, go ahead.

URBAN SYSTEMIC INITIATIVE

Mr. DELAY. About the Urban Systemic Initiative that was begun in 1993. The purpose of the Urban Systemic Initiative was to develop the scientific and mathematical capability of children who reside in urban environments. There are four Texas cities that are eligible, and I believe 11 proposals were submitted and there will be six to eight awards in 1994.

I also understand that Dallas, San Antonio, El Paso, have submitted proposals and Houston will submit theirs this spring.

Dr. WILLIAMS. July.

Mr. DELAY. In July, for 1995 funding, I think. How is Texas doing in terms of their proposals, can you tell me?

Dr. WILLIAMS. Well, yes. They are one of 11. And they are, in fact, at the second phase of review. In about a week I can tell you. But three of the four cities in Texas have applied.

Mr. DELAY. Okay. And what sort of things differentiate these proposals? Can you tell me that?

Dr. WILLIAMS. The scope. The idea is rather than funding—I will purposely use an example, but I purposely use this example. Rather than funding a fraction of the students in San Antonio, like one does in TexPrep, what this program asks the San Antonio school districts, which is more than one, as you know, to do as a collective, restructure K to 12 math and science education for all the students. So it is the whole system involvement. That is what San Antonio is doing, that is what El Paso is doing.

Obviously, they do it differently because they have different levels of circumstances. Houston has its own plan; Dallas has its plan.

So they build on the existing strengths that they have in the city, but the idea of systemic is that they do the whole system, all schools for all students.

Mr. DeLay. I understand the program is supposed to challenge the status quo.

Dr. Williams. That is right.

Mr. DeLay. What sort of things are being proposed in the proposals you have received?

Dr. Williams. Ensure that the teachers have the requisite competence and skills, so there is enormous staff development or retraining programs for math and science teachers. They have to put in place a math and science standards based curricula, which barely exists in most of the schools. Math and science education has to be a 12-year venture, as opposed to ending in the 9th grade as it does for most students presently.

If you are going to extend it, you have to make creative use of technology in the instructional program. The assessment of students' performance has to map the structured program.

They have to deal with a whole series of policy issues. One policy issue, for example, would address not having Chapter I math instruction operate counterproductively to this program. You understand what I mean? Doing remediation when, in fact, the emphasis should be on performance. And lastly, issues of—policy issues that even bear on governance, how they allocate, how they use their own resources, and the broad issue of tracking.

So it basically says against many years of operation and an awful lot of history, awful lot of structure, all of which is not leading to the desired outcome, this program invites them to basically disassociate themselves from all of those practices and instructs you, as it should, to afford every youngster the opportunity to learn science and mathematics. And to have one system, which means they have to change their existing system. This is not an NSF project leaving constant what they are currently doing.

Mr. DeLay. That is good. Thank you, Mr. Chairman.

Mr. Stokes. Sure. By the way, you didn't get a chance to ask any general questions this morning. Do you want to ask any questions?

Mr. DeLay. No, that is okay.

ENVIRONMENTAL BIOLOGY REQUEST

Mr. Stokes. Dr. Lane, for fiscal year 1995, the Foundation is requesting $2,348,700,000 for the Research and Related Activities, an increase of $175,000,000 above the 1994 level, or about 8.3 percent. In turning to page 81, Biological Sciences, the Agency is requesting an increase of $25,160,000 for fiscal year 1995, an increase of about 8.7 percent.

According to the justification, the largest increase in the Biological Sciences activities is for environmental biology, about 11.4 percent. What type of activities are conducted in this area and why did it receive the largest increase?

Dr. Lane. Well, as I mentioned earlier, Mr. Chairman, environmental research is one of the major strategic areas of emphasis at the NSF, and there is a strong biological component to that. The specific areas, and then I would like to ask Dr. Clutter to comment, but some examples of areas that would be covered under this heading are genetic, biophysical and cellular mechanisms by which organisms respond to environmental signals and work on the genes involved in plant interactions, biodiversity, and the role of maintaining the health of the environment, support of biological field stations.

But perhaps with your permission, Dr. Clutter could add a further comment.

Dr. CLUTTER. I would be very happy to answer that. I think you are well aware of the Global Change Program that is an interagency initiative, which is part of our overall investment in the environment. The global change program has priorities that are developed across all agencies. the reason for the very large increase in biology this year is because living organisms have finally been recognized as part of global change. We need to have much more information, especially in the area of terrestrial ecology. And that accounts for the very large increase in the biological sciences. But that is only part of the overall program that relates to the environment.

As Dr. Lane said, we are very interested in all areas, all levels of inquiry from the molecular, genetic, through cells, organs, organ systems, to the ecosystem level of inquiry. And that is the kind of thing we are doing.

CENTER FOR ECOLOGICAL SYNTHESIS AND ANALYSIS

Mr. STOKES. The Center for Ecological Synthesis and Analysis has been discussed on at least two occasions in this subcommittee. Now, I see on page 85 that the request for the center was increased to a total of $2 million in fiscal year 1995. Has this center been established yet?

Dr. CLUTTER. No, it hasn't. We are about to release the program announcement inviting proposals for this particular center. And as you recall last year, I told you that this is not necessarily a center with walls. This can be a center without walls, that is, a group of institutions interacting via their own network. But we have not received the proposals yet. We are about to go out with the request.

The reason for the large increase is because we intend to start—as Dr. Williams said, we will have planning in 1994 and the level of funding for the center is expected to be about the $2 million level by fiscal year 1995.

HPCC BLUE RIBBON REPORT

Mr. STOKES. Turning to the computer and information science and engineering activity, I note that the agency is requesting $273,500,000 in fiscal year 1995, an increase of almost 14 percent. Within the subactivity is high performance computing and communications, which is distributed across the various components. Last year the Foundation received a report from a blue ribbon panel on high performance computing. I understand that the report recommended NSF should make some directional changes. Can you comment on this report?

Dr. LANE. Mr. Chairman, that report—I was actually on that committee before I had to resign to serve the public in other ways, and so I didn't write any of the report. I would want to be quick to point out, but it was an outstanding panel, present company excepted, and they worked very hard over some period of time to deliver a thoughtful report. The Board received that report, has asked the NSF staff to provide guidance and an implementation plan and a set of recommendations, and that report is in draft form right now, I believe.

Let me ask Dr. Ciment if he would add.

Dr. CIMENT. We formed an internal working group under the cochairmanship of two individuals, Peter Azberger and Bob Voigt, from the BIO and CISE directorates, respectively. They are working with an NSF-wide group of program directors and staff to develop an implementation plan. They have a draft that is about to be circulated to the assistant directors.

As you know, the Branscomb Blue Ribbon Panel report did call for maintaining the supercomputer centers, doubling or increasing the instrumentation program, and primarily looking for the balance between the various types of environments, from the workstation environment indeed up to the Apex or what they call the teraflops environment.

Clearly, they were working in an environment that didn't have to look at the budget directly. Our staff is looking at the budget, what has been realized, what is expected, and are developing appropriate recommendations that will go to the director.

Dr. LANE. We plan to discuss this with the Board at its May meeting, Mr. Chairman.

INFORMATION INFRASTRUCTURE TECHNOLOGY AND APPLICATIONS

Mr. STOKES. Under the subactivity we were asking you about before, NSF is proposing a new initiative, the Information Infrastructure Technology and Applications. Can you explain this initiative for us?

Dr. LANE. Well, Mr. Chairman, this is an important part of high performance computing and communication. It is a part that directly addresses the needs to develop the larger national information infrastructure that will apply to education, health care and civil infrastructure in many important areas of application. And I would like Dr. Ciment to put the detail on that.

Dr. CIMENT. Be happy to. Thank you.

Mr. STOKES. Sure.

Dr. CIMENT. The IITA refers to the research and development part of the high performance computing that supports the national information infrastructure initiative that the White House announced last year. That initiative refers to producing tools, services and products to support the information-intensive requirements of the broad enterprises of our Nation.

As recognized in that initiative, the high performance computing program is the bedrock for enabling technologies for that information infrastructure. And so the IITA, which is going to develop the services, the tools, the support environments and the interfaces, is the research part of the NII. Also included in IITA are a very important category of applications called the national challenges.

These are information-intensive applications that have important societal impact. For example, in manufacturing, digital libraries, health care and government information services, and a variety of other activities.

NSFNET

Mr. STOKES. All right. One of the facilities under this activity is the NSFNet, the information backbone for the entire U.S. scientific community. On page 98 of the justification, transition to the very high speed backbone network services will be completed in fiscal year 1995. It also states that the 1995 request for NSFNet is $46,160,000.

Does this include the entire cost of NSFNet or are there other expenses for this network included elsewhere in NSF's budget?

Dr. LANE. Dr. Ciment.

Dr. CIMENT. The NSFNet request of $46.6 million in 1995 includes support for the transition to the new backbone system, as you indicated, and it also refers to the maintenance of the old backbone system that has to be maintained while we are in this transition period, and also refers to support for connections in a variety of other programs supporting institutions, educational and other research institutions' connections.

Mr. STOKES. How does this activity relate to the Administration's Information Superhighway Program?

Dr. CIMENT. That is a good question. The NSFNet, of course, is just one of several agency networks that interrelate. But we sort of feel, of course, proud about the accomplishments of this network, because the NSFNet has become the backbone, the preferred backbone for the research and education environment.

With our transition to the very high speed backbone network service that we have just been authorized by the Science Board, we are moving into a realm of applications that are really at the leading edge of information intensive applications. And so we think that this will be the area where interesting new experimental activities will take place, and will support the wide interests—across all the directorates of NSF, and indeed multi-agency interests in this area.

Mr. STOKES. Can you in some way relate this to how it is going to affect the average American's life?

Dr. CIMENT. Well, that is a good question. We must bear in mind that this is a research and educational, quasi-experimental network system that we are providing. In fact, the former one that we are phasing out through the period of April, 1995, has become almost a commodity level network for the research and education community. That is why we are leaving it.

We think that, of course, by prototyping all sorts of applications in digital libraries and health care delivery systems and manufacturing, all these variety of application areas, we will have profound impact on a variety of areas. I think that the companies that want to—that write proposals in this area, that work with the academic people in this area, the various players all are looking to prototype new activities in this environment. So I think we will have profound impact in the long run.

Mr. STOKES. When you state that, is this your view?

Dr. CIMENT. That is absolutely, of course. But I think that is the view of the people who have put their resources forward in terms of trying to work in this area. And, in fact, as I said earlier, about the digital libraries proposal, we had a vigorous response to that.

CIVIL INFRASTRUCTURE

Mr. STOKES. Thank you. Turning to engineering activities. The Foundation is requesting $320,410,000 for fiscal year 1995, an increase of about 8.6 percent, one of the Foundation's strategic initiatives is in the area of civil infrastructure systems within this activity.

According to page nine of the justification a total of $54 million is being devoted to this activity in fiscal year 1995. What is NSF's role in comparison to other Federal agencies in the civil infrastructure systems initiative?

Dr. LANE. Dr. Bordogna.

Dr. BORDOGNA. As with most of where NSF's talent lies, we are looking very much at the discovery end of things. The main idea is that as we get to renewing the infrastructure over a period of time, we must do it intelligently. We have a variety of thrusts that we focus on across the entire Foundation. And as I list them, you will see we need the entire set of disciplines to invest in civilian infrastructure properly.

One thrust is what we have named deterioration science. We don't really understand very well why things deteriorate, especially when they are being used dynamically every day, like a bridge. When we build a bridge, we know how it is going to react when it is new because we designed it in a certain way. But as the trucks roll over every day, the weather hits it, wind blows, over time we really can't predict well when that bridge will need to be replaced or retrofitted or repaired. So it is deterioration science, the chemistry of it, the physics of it, in which basic research will be done to understand the deterioration process.

The next thrust is assessment technologies. Over the last 40 years the United States has developed a number of ways to assess both physically and mathematically the condition of things. How do we assess the condition of a bridge? We may do it by scanning it with some kind of radiation now, sort of like a bridge "radar." And so on, there are many examples of this. We want to apply these new technologies so we can get a better handle on assessing the condition of a structure at any moment in time.

The third is what we call renewal engineering. This has a lot to do philosophically somewhat with the engineering that has been done in the last 40 years. Most of it has been throwaway. For example, you throw a circuit board away and the repairman puts a new circuit board in. Well, you can't throw away $17 trillion of built infrastructure. You have to renew it and the idea is to renew it intelligently.

For example, for earthquakes, let's bring all the knowledge to bear on what we know about earthquakes to structures, so when we renew them—a typical word on a bridge in California is retrofit—we do so in a rational way.

The fourth is something that most people don't think about much, but it is probably paramount, and that is called institutional effectiveness and productivity. In the civil infrastructure, when you are going to do a big project, it is a regional matter, has to do with bond issues, it is complicated, it is legal, it has environmental aspects to it, so you can't begin to move to renew the infrastructure unless you take care of its institutional aspects.

As with most things we do, not with all, a partnership is required here, so we will work with the Corps of Engineers, for example, which has extensive responsibility in infrastructure activities. We are working very closely with the construction people over at NIST, for two reasons. First, infrastructure deals with construction and, second, NIST has a focus on the deployment of knowledge. So coupled together, we can discover knowledge and get it deployed into the marketplace.

Even with the Technology Reinvestment Project, you would be surprised that there are several tens of millions of dollars there related to infrastructure. A famous one is the prospective composite bridge out in San Diego. How do we make a nonmetallic bridge? If you look at that proposal, in addition to having industry and academia and the political region involved, a big part of the project is dual use—if we can learn how to make lightweight nonmetallic bridges, we can learn how to make portable bridges that ford rivers when the former bridge has been destroyed. In any case, that is a sample of the intellectual part of it and what NSF's role is at the discovery end and then working with other agencies to get this knowledge out in the marketplace.

UTILITY OF INFRASTRUCTURE RESEARCH

Mr. STOKES. I suppose, just logically following up what you are saying, that notwithstanding the type of research that is conducted, you have no way of ensuring that this research would be utilized in retrofitting and so forth?

Dr. BORDOGNA. Well, I think ensure is a tough word, but I can give examples where retrofitting, which for example prevented bridges in California from falling down, derived directly from NSF research. Thus this new knowledge was deployed into the marketplace. And that is a fact. So it is already going on.

The Civil Infrastructure System Program actually is a collection, an integration of a number of things going on for years. Can we now pull them together and renew the Nation's infrastructure intelligently with our partners? So the retrofitting is an example; it is one example.

The USC hospital that didn't fall down was a newer kind of a building. That hospital was built on sort of a floating isolation system. And it was partly—we didn't know if it was going to fall down, but it didn't, so we are back in there. We know it didn't, so that research has been deployed. Knowledge comes back and we work with our partners.

Now, the ensure part, which is, again, institutional effectiveness and productivity, you can't renew infrastructure or even build it without the codes being followed. And the codes are very far behind the new knowledge. And so it is a very hard political, local, regional community effort to change those codes. This has a lot to do with jobs being changed and so on. But this is being done. Codes have been changed over the last 10 years.

NIST is most responsible for codes, so the partnership has actually led to code changes. That is probably the toughest job of all.

VIOLENCE RESEARCH

Mr. STOKES. In the committee's letter responding to NSF's 1994 operating plan, we requested the Agency consider the feasibility of establishing a science and technology center focused on violence research.

Dr. MARRETT. Yes, we promised a report by the beginning of May, but I can tell you there has been substantial activity since the time we received the letter. In fact, tomorrow there will be an interagency gathering that NSF is sponsoring.

One of the issues, as my colleague just mentioned, are attempts to work with other agencies. On this front those coming tomorrow will be from the National Institute of Justice, Centers for Disease Control, National Institute of Mental Health, and a few other parts of the National Institutes of Health. This is for a discussion of what the needs are and for us to outline for them the kinds of needs that we see for large-scale longitudinal research. So we will use that as one of our strategies for defining more sharply what that research can help yield.

Mr. STOKES. The issue of course, is the extensive violence now occurring in American society. In particular, the concentration on black-on-black crime that is occurring in communities throughout America, as well as other forms of violence not only in the inner city, but now spread to suburban areas. Is this what we are talking about?

Dr. MARRETT. That is exactly right. One of the tasks, as we see it, will be to try to reveal if there are differences. That term "violence" covers a large group.

One of the responsibilities for an agency such as we would represent is to understand conceptually where are the commonalities, where are the differences, because that is the only way in which you can have any effective programs and policies. So for the moment, we have got the broadest spectrum possible with the idea of refining for them, and that is the kind of activity that both conceptual and research development will enhance.

VIOLENCE CENTER FEASIBILITY STUDY

Mr. STOKES. Now, you were going to do some type of feasibility study, too, weren't you?

Dr. MARRETT. Yes. We already have. That is what will be coming in.

Mr. STOKES. You have it, okay.

Dr. MARRETT. We are doing the study right now on the feasibility of establishing a particular center. We are evaluating the need. We are asking what is the appropriate mode and level of support for such research, and who would be the appropriate actors to be involved.

And one final comment on that. The discussion just now on civil infrastructure is related, because there is one way of interpreting it as in terms of public infrastructure; there is another in terms of talking about building communities to enhance civility. And in that sense, there is a linkage across the several things that we are doing.

Mr. STOKES. Very good.

Now, you are going to develop some type of report by May 1; right?

Dr. MARRETT. That is right.

Mr. STOKES. So are you still on track?

Dr. MARRETT. We are very much on track, yes, there is no problem with that.

ANTARCTIC ENVIRONMENTAL ISSUES

Mr. STOKES. That is good to hear.

Thank you.

Let's look at the polar programs within NSF. For fiscal year 1995, the Foundation is requesting a total of $225,430,000. This is an increase of $4,730,000 or about 2.1 percent. There are several environmental issues regarding the Antarctic.

Can you give us, Dr. Lane, an update of NSF's clean-up activities?

Dr. LANE. Mr. Chairman, I would like to turn to Dr. Neal Sullivan who is the Director of our Office of Polar Programs.

Mr. STOKES. Okay.

Dr. Sullivan.

Dr. SULLIVAN. Good afternoon, Mr. Chairman.

Well, after a five-year and $85 million initiative, we are about to bring that initiative and the resources that have been brought to bear in addressing safety, environment and health improvements, to an end this year, in particular.

We will be continuing to fund that out of other resources. But at this time, we have conducted major cleanups at McMurdo Station, retrograding more than 20,000 tons of waste material from the station that dates back to the very early dates of the program.

We have also cleaned up some of the former stations at Hallet Bay, which is north of McMurdo, and East Base, and also old Palmer Station on the Antarctic peninsula. As a part of our environmental improvement, we have also stopped any open burning.

We have cleaned up a number of the areas that had been used as landfill in the Fortress Rocks area, and we have retrograded that material to landfills, primarily in the United States, with the agreement of the States of California, and Washington, most recently. We have also ceased the activities and use of an incinerator in the Antarctic. As a result of an examination of the materials released and finding that it did not meet Environmental Protection Agency standards, the National Science Foundation made the decision to close that facility and to retrograde the materials that had been incinerated in Antarctica, rather than to continue to burn them.

We hope with the advent of new technology which you have heard a great deal about from some of the earlier assistant director giving testimony here, that in the future we may find incinerators that release nothing but carbon dioxide and water, and so we would like to hold open the possibilities that something resulting from that new technology might help us in a more cost-effective way of addressing waste material.

We have also developed a very considerable oil spill prevention program and control program that involves adding a lot of new piping, pipes that self-close when they are broken. We have built berms or catchment basins around the oil tanks in the McMurdo area, around our fuel tanks that supply the aircraft and supply the fuel for housing scientists and support staff.

So our program has been fairly comprehensive in addressing the environmental issues that were brought to our attention, I would say, during the 1980s. And I would emphasize that activities are still not complete even though that initiative funding is exhausted right now. We still have issues to deal with and will continue to do so at the level of about $8.5 million in FY95 to address those continuing problems that we have seen. Not new problems, but problems that have existed for some time.

Mr. STOKES. Are there any funds requested in your request for fiscal year 1995 for these activities?

Dr. SULLIVAN. They are. We do have the $8.5 million request that is now a part of the operations and science support section. So they are not set aside as they were in the initiative, but they are there, nevertheless.

ARCTIC RESEARCH VESSEL

Mr. STOKES. In the fiscal year 1994 appropriations bill, the committee included language prohibiting expenditure of funds on an arctic research vessel unless it was built in a U.S. shipyard. Is that provision being complied with?

Dr. LANE. Maybe Dr. Corell would perhaps get you up to date on that.

Dr. CORELL. I am pleased to do so.

As you know, the Senate asked GAO to evaluate the modes by which the NSF might acquire this vessel. That GAO report has not been completed. We have talked with them recently, and they are at the very beginning of that study. They have just started their investigation. Their job is to determine whether it is in the best interests of the United States to lease, lease purchase, or outright purchase such a vessel.

The preliminary design studies last year including wave tank studies and things of that nature, is in a hold mode.

Mr. STOKES. I see.

AIRCRAFT ACQUISITION

How many LC–130 airplanes are currently in the pipeline for acquisition for the Antarctic program?

Dr. LANE. Dr. Sullivan.

Dr. SULLIVAN. Yes, Mr. Chairman, right now since the 1990 report on the future requirements for aircraft to support the Antarctic program, we have had three aircraft in the pipeline. Two of those aircraft were funded in the 1992 appropriation of about $97 million, and they are anticipated for delivery to the Air National Guard of New York, the 109th Air Guard, during next fiscal year.

A third aircraft, which was funded in 1993, is slated for delivery in 1996. So those three aircraft are in line and as a result of Senator Byrd's request, we are currently reevaluating and continuing to evaluate our aircraft needs through the end of this century. But right at this time, we are up to date, and actually if the deliveries take place as they are anticipated in 1996, we will be about a year ahead of the prescribed delivery for these aircraft.

DOD SUPPORT FOR THE ANTARCTIC PROGRAM

Mr. STOKES. What is the current status of the discussions with the Defense Department relative to supporting the Antarctic program?

Dr. SULLIVAN. Well, as you know, Mr. Chairman, the Antarctic program has derived a great deal of support from the Department of Defense, virtually from its inception. And very recently the Navy portion of that support in DOD has reevaluated its role and its position, I believe, will be considered by the new Assistant Secretary for Installations and Environment once that individual is confirmed.

But in the meantime, the Navy has developed a proposal, a proposed withdrawal plan that would take place over approximately a five-year period. And the NSF staff and Navy staff who are detailed to the National Science Foundation in the Office of Polar Programs have been working on the report, have been liaising with the Navy, and anticipate a draft report to the Navy by April 1st, so that we can continue those discussions and deliver as requested by May 1st a final report.

CRITICAL TECHNOLOGIES INSTITUTE

Mr. STOKES. Let's now turn to the Critical Technologies Institute.

NSF is requesting a total of $2 million for this program, an increase of $500,000 above the 1994 level. Is my understanding correct that this $2 million NSF request is a pass-through to the Institute to support the Office of Science and Technology Policy?

Dr. LANE. That is right, Mr. Chairman.

Dr. Bernthal could comment further on the Institute.

Mr. STOKES. Okay.

Dr. Bernthal.

Dr. BERNTHAL. Well, the answer is yes. As our Director has indicated, it is a direct pass-through to support OSTP's activities, some of those congressionally mandated.

Mr. STOKES. What types of activities are funded through this component?

Dr. BERNTHAL. There are a variety of activities. One with which I am particularly familiar is the biannual production required by the Congress of a report on critical technologies by a panel that is appointed by the Director of the Office of Science and Technology Policy. I chaired that panel which rendered the most recent report just over a year ago.

There are certain other reporting requirements, including a recent machine tool study that I understand is being worked on. One of the most important recent undertakings, this is not a congressional mandate, has been to take a very thorough, comprehensive look across all the agencies to try and do a taxonomy of all Federal investments in research and development.

I understand that report, I believe, is about to be rendered to the Office of Science and Technology Policy by the Critical Technologies Institute.

So basically a number of activities that touch on matters of interest to the Congress and to the Administration involving critical technologies or the broad programs in research and development are undertaken at the request of OSTP. The National Science Foundation is not directly involved in issuing those requests, however, to CTI.

Mr. STOKES. Tell us why this activity is requested in the NSF budget rather than the OSTP budget?

Dr. BERNTHAL. Well, there is some history in that, Mr. Chairman. As I recall, the Administration requested that the funding for CTI be set up that way. The initial authorization was contained in the National Defense Authorization Act in fiscal year 1992.

It directed DOD to make those funds available for the National Science Foundation to fund Critical Technologies Institute. However, the Director of OSTP chairs an operating committee composed of members of the heads of a number of the leading interested agency, Commerce, NASA, NSF, Energy, and so on. That is simply the way it was set up.

The decision was not to put that funding directly in the OSTP budget, but rather because of our management, oversight capabilities, to have the money pass through the National Science Foundation. And so far that has worked quite well.

By the way, the NSF is also the contracting procurement officer and the Rand Corporation was selected as the contractor.

MAJOR RESEARCH EQUIPMENT

Mr. STOKES. Thank you.

Let's turn to major research equipment. This year, the NSF has restructured several of its accounts. The agency is proposing a new account, major research equipment, and fiscal years 1993 and 1994 activities now included in this account were funded through the research and related activities account. For fiscal year 1995, the request for MRE is $70 million, an increase of $18 million above the 1994 level, or almost about 35 percent.

Over the past several years, NSF has requested and the committee has provided funding for a number of major research facilities.

Dr. Lane, do you believe the Agency has now achieved a balance in its requests between the funding of larger-type facilities and the smaller science activities?

Dr. LANE. Well, Mr. Chairman, I don't think I can answer with confidence just what that balance ought to be. It is a balance that is struck on an ongoing basis in our effort to be sure that we make available the facilities that are necessary to get the research done. So our responsibility is to see to progress in science and mathematics engineering in the country.

Some kinds of research require major facilities, they are just more expensive than others, and it is one of our responsibilities to provide access to the instrumentation that is required. Sometimes that means using facilities constructed by other agencies and sometimes we are constructing them ourselves. So it is an important policy issue as to just what the balance should be, and certainly something that we discuss with the Board on occasion and will be continuing to do so as a part of this planning process.

Mr. STOKES. Do you expect to request funding for the start-up of any new facilities in the next year or two?

Dr. LANE. The two facilities that are in this new account right now are the LIGO, the Laser Interferometer Gravitational Wave

Observatory, and the Gemini Telescope project. And those will be under construction for a number of years yet.

There are other projects under construction that don't appear in this account, smaller projects, and obviously when the construction is finished they will go into operations. So I am not aware of anything new that has not been mentioned in the budget submission, but we, of course, as we are preparing the 1996 budget and as we are talking about future planning, will be looking to see what other kinds of instruments might be necessary.

MRE SCHEDULES

Mr. STOKES. Dr. Lane, in the justification a time schedule with milestones is set out for the construction of various large-scale projects now funded out of this account. For two of the relatively new construction projects, the LIGO and the Gemini eight-meter telescopes, the justification states that the attainment of these milestones is dependent on several factors, including appropriate funding schedule and progress and technology development.

Can you explain what progress and technology development means?

Dr. LANE. Well, I would like to ask Dr. Harris, who is the Assistant Director in MPS, which directed both these projects.

Mr. STOKES. Sure.

Dr. LANE. But let me just add a comment; that I did visit the LIGO facility recently, to see what kind of technological progress was being made with my own eyes, because the reports, in fact, have been very, very good. That is a project that has really done extraordinarily well in moving forward on those quite substantial challenges. And I was very impressed in that visit.

But I would like Dr. Harris to comment in detail.

Mr. STOKES. Sure, Dr. Harris.

Dr. HARRIS. My pleasure, sir.

The Gemini project, the telescope project, seems to be moving along quite nicely. The telescope will be built in Hawaii and they expect to see first light on schedule in 1998.

The second telescope will be built in Chile and they expect to see first light there in the year 2000. I don't expect there at this time to be any surprises.

They are using a new type of mirror, but other countries are using that mirror as well and it has passed all technological tests so far.

The LIGO project that Dr. Lane was just referring to, is probably one of the most challenging projects we have ever undertaken. It is a new kind of project, you are pushing the limits of technology, lasers, optics, and seismic isolation. But the progress to date has been what everyone expects. It is a coupled R&D project with a construction project going on, and it is a major technological challenge for everyone, but I think it is a challenge that both the Cal Tech and MIT scientists are well-prepared to take.

If there are surprises, we will surely keep you informed of anything that comes along. The reviews so far have suggested no show stoppers—that the goals can be achieved—but it is a challenge.

Mr. STOKES. Is the technology still in the development stage?

Dr. HARRIS. Some of the ultimate lasers, optical systems and isolation mechanisms will be in the development stage for advanced detectors even when you finish the construction of the LIGO Project. But the basic ability to start the project and to construct the LIGO facilities at Hanford, Washington, is in good state right now being prototyped on a 40-meter scaled model. It is the continuing improvement for the ultimate in detection that is the trick.

FUNDING EFFECTS ON MRE SCHEDULES

Mr. STOKES. Does the statement that we have asked you about mean that, should we not provide the funding requested, the costs would escalate and the final development be delayed?

Dr. HARRIS. Any time you stretch out a project, you run up the cost, as you well know. Our purpose is to try to contain the cost as responsibly as possible, and we are following the cost process very carefully. We are having a review of that process again in April and we do that annually. So far, tough outside committees found the costs are on budget. The only cost increases are due to stretch outs because of earlier delays.

Mr. STOKES. If Congress chose to fund these projects at a level higher than requested, would the construction be completed sooner?

Dr. HARRIS. I think the construction probably can't go a whole lot faster. It is on track now. You have got environmental things to finish in Louisiana that haven't quite finished, and the Hanford, Washington, rough grade in is supposed to start this spring. So I think the construction process will be on target.

The project will have a steady state funding level of approximately $50 million a year and that is the jump that we need to take probably next year to get the construction to meet the ultimate cost requirements.

COOPERATION WITH INTERNATIONAL PARTNERS

Mr. STOKES. I want to again note the emphasis on milestones in this section and ask how dependent are these milestones on the cooperation of international partners, both with LIGO and Gemini?

Dr. HARRIS. They are two very separate activities. As you know, the Gemini Project is truly an international partnership and in the best sense of the word. Everybody started together, and with the help of this committee we have come a long way in that partnership. That partnership depends upon each of the major partners, in this case, the U.K., Canada and the U.S., controlling the project responsibly.

The U.S., the NSF has executive agency responsibility, and again all of the technology seems to be going well. So far they have let approximately half, I believe it is, of the construction contracts that they need to get that project underway. And the project Director, Sidney Wolf, tells me everything is in good shape.

The LIGO Project is a different kind of project in the sense of international cooperation. There are other countries that are building LIGO detectors, if you like. And there is a cooperation and a synergy that works between them, but it is not the same kind of synergy as required in the Gemini Project.

So I believe we have more control, if you like, of our own destiny in the LIGO Project in terms of defining the parameters and meeting them. It is much easier to work within your own boundaries than it is to try to stretch things with other governments. But that challenge has proved to be a good model for us, too.

LIGO COMPLETION

Mr. STOKES. Is LIGO still scheduled for completion in 1997?

Dr. HARRIS. It may be stretched by about six months into 1998 because, as I believe you know, the committee was informed we had a delay in the funding this year to reexamine the project as it went from primarily an R&D project to a construction project, and the funding was delayed for approximately four months. We have just released the funds.

Dr. LANE. We chose to delay the funding?

Dr. HARRIS. We chose it, yes, sir; yes, sir. Make sure there were no surprises later on.

Mr. STOKES. All right.

Dr. HARRIS. We will inform you after the cost review in April if there is a slight delay of six months or so on this thing.

LIGO MANAGEMENT

Mr. STOKES. All right.

I guess we had picked up the fact that the completion date had changed from previous justifications. We are also aware that the LIGO Projects had some management problems, and NSF froze all funds temporarily while these issues were being addressed.

Can you give us a little history on the management problems surrounding LIGO?

Dr. HARRIS. Well, the project for the last several years has been primarily a R&D project, highly focused, primarily on the Cal Tech campus with the cooperation from MIT. As the project matured and it began to develop the reality of a construction project, the community of scientists wanted to be more broadly involved.

We had several reviews over the past years, and recognized that it was time to ensure that the partnership between MIT and Cal Tech was stronger, there was more synergy there. And it took a little while to work that out and to make the transition from a highly focused R&D project to one that was, if you like, more broadly based and did the construction in a different way, and allowed some of the best scientists from other institutions to contribute to this technology effort that we were discussing earlier, the laser development for advanced detectors.

So we tried to strengthen this now by bringing more people into this. And it followed two major reviews that took place over the past year as well, that suggested this transition was necessary.

It was initiated actually by the Presidents of Cal Tech and MIT, they reviewed the project and also agreed this project would be strengthened and recommended it.

Mr. STOKES. Will the changes made as a result of the management issues cause any delays in construction or change in the cost of the project?

Dr. HARRIS. At this time, sir, I don't expect any major changes at all, but I will keep you informed. We do have a cost review scheduled for April, and we are going to review completely the cost and the construction schedule. As I mentioned a few moments ago, the delays may cause a slight slippage of a few months, but I would rather give you a definitive answer after this review.

LIGO OPERATIONAL COSTS

Mr. STOKES. I note in the justification that the operational costs are $12 million per year. Is that for the first year of operation or is that an accurate number for the outyears as well?

Dr. HARRIS. That is a good estimate for the outyear costs of an expensive operational facility like that.

VIRGO

Mr. STOKES. Currently, LIGO consists of two facilities. In order for fundamental physics experiments to be conducted to detect gravitational waves, identical detectors are needed. However, to enhance the study and locate the direction of astronomical sources of gravitational waves, four geographically separate but technically compatible detectors are required.

According to the justification, a memorandum of understanding for joint cooperation has been signed for the Virgo Project, a French and Italian collaboration. Can you tell us a little more about what is included in this MOU?

Dr. HARRIS. I don't have the details with me, sir. I can get that for you. The idea there is to share the technology developments, the Virgo Project is going to benefit from some of the research that we have done and buy some of the U.S. materials and things like that.

But I will be glad to get you the details. The scientists are working closely together on that one.

Mr. STOKES. If you will just expand on that for us in the record, we will appreciate it.

Dr. HARRIS. Yes, I will. I will give you a copy of the MOU as well.

Mr. STOKES. Good.

[The information follows:]

MEMORANDUM OF UNDERSTANDING FOR THE VIRGO PROJECT, THE LIGO PROJECT, AND PMS ELECTRO-OPTICS

The French CNRS and the Italian INFN have both made the final decision to proceed with construction of VIRGO, one 3 km facility analogous to one of the two LIGO installations. A site near Pisa has been identified as its likely location. A memorandum of understanding between the Virgo Project, the LIGO Project and PMS Electro-Optics on the development of technical components has been signed and is attached for your information.

Memorandum of Understanding
among
The VIRGO Project,
The LIGO Project
and PMS Electro-Optics
on the
Development of Test Masses
and Other Large Optical Components for
Laser Interferometer Gravitational-Wave Detectors

This memorandum of understanding establishes a cooperative program to develop high performance optical components for gravitational wave detectors and to expand the existing channels for exchange of technical data concerning optical component performance and testing.

One of the principal technology challenges for the development of laser interferometer gravitational wave detectors is the fabrication of the optical components for the interferometer, particularly the large optical components such as the test masses and the beamsplitters. Although the specifications for the test masses and other large optical components for the LIGO and VIRGO detectors will likely be different in their details, the general requirements will be similar and will make strong demands on the current state-of-the-art. These optics must combine the technology for very low-loss coatings (which have been developed by PMS Electro-Optics) with techniques to achieve extremely high coating uniformity over large areas.

Two development efforts are envisioned by the parties to this agreement:

- PMS and the VIRGO Project have entered into an agreement under which PMS will provide technology and assistance to Dr. Jean-Marie Mackowski's group at the Institut de Physique Nucleaire, Lyon (one of the members of the VIRGO project). This group will undertake a program to develop techniques for making large low-loss optics with reduced figure errors for the VIRGO Project.
- The LIGO Project will explore with PMS the feasibility of a parallel effort using different techniques to develop large low-loss optics with suitable figure. The LIGO Project and PMS will jointly define the goals of this effort, and PMS will submit a proposal, including costs and schedule, to the LIGO Project to perform their part of the proposed work.

Because of the critical nature of the optics for the VIRGO and LIGO projects, it is advantageous to pursue the development of the technology to produce these components cooperatively. To achieve this objective, the parties to this MOU agree to the following:

1. The VIRGO and LIGO projects will exchange technical information regarding the requirements and specifications for interferometer optical components. They will compare initial assumptions, analysis techniques, and conclusions regarding the influence of optical losses and figure error on interferometer performance. The goal of this interchange is to ensure that all aspects of the specification process receive adequate attention and review. However, each project will be responsible for determining its own detailed optical specifications.
2. Test data concerning the performance of optics shall be freely exchanged among the three parties. Periodic meetings will be held to discuss results and plans for further testing.

   Development of new test techniques will be pursued cooperatively. Descriptions of test apparatus, test methods and data analysis techniques will be made available to all parties to this agreement. When practical, optical components tested by one of the parties to this agreement may be made available to the others for comparison and cross-calibration. These steps will ensure the accuracy and consistency of the test data.

   All test data exchanged under this agreement remain the property of the originating party, and shall not be released to outside parties without the consent of the owner.
3. All parties agree to make a good faith effort to ensure that both the VIRGO and LIGO Projects are able to acquire suitable optical components.

3/17/93
Dr. Alain Brillet — Date
VIRGO Project

Dr. Robert Knollenberg — Date
Director of Research and
Development
PMS Electro-Optics

19/3/93
Dr. Adalberto Giazotto — Date
VIRGO Project

3/10/93
Dr. Rochus Vogt — Date
LIGO Project

VIRGO INTERNATIONAL COSTS

Mr. STOKES. Are the entire costs of these two detectors outside the United States to be borne by our international partners?

Dr. HARRIS. The Virgo you are talking about now?

Mr. STOKES. Yes.

Dr. HARRIS. Yes, sir. We are involved intellectually and cooperatively so when they start the experiments, we can be measuring the same things.

GEMINI

Mr. STOKES. For fiscal year 1996, the request for Gemini telescope development and construction is $20 million, an increase of $3 million above the 1995 level. The total budget for Gemini telescopes is $176 million, of which NSF is providing 50 percent, or $88 million, with the remainder provided by some of our international partners.

Who are the other international partners and how much is each contributing to reach the total of $88 million?

Dr. HARRIS. United Kingdom and Canada, those are the two major partners, and Brazil, Chile and Argentina. The U.S. is 50 percent. The U.K. is 25 percent; Canada is about——

Dr. LANE. Fifteen.

Dr. HARRIS [continuing]. Fifteen percent, and then the other three countries come together for the balance of 10 percent.

Mr. STOKES. Now, is that part not decided yet?

Dr. HARRIS. I am sorry?

Mr. STOKES. Is that part not decided yet, on the other three countries?

Dr. HARRIS. No, no, everybody signed the MOU.

Mr. STOKES. Everybody signed?

Dr. HARRIS. Yes, sir. Last year, in fact, one of the really helpful parts to get that signed, a former staff member actually was down in South America and helped finalize that for us.

Dr. LANE. Mr. Chairman, did you want to know the distribution of the other three, I mean how much each one is putting in?

Mr. STOKES. If you just provide it for the record.

Dr. HARRIS. It is a couple percent each, but I will get it exactly for you.

[The information follows:]

INTERNATIONAL PARTNERS IN THE GEMINI 8-METER TELESCOPES

The two major international partners in the GEMINI telescopes project are the United Kingdom at 25% and Canada at 15%. The other three partners are Chile, contributing 5%, Argentina at 2.5%, and Brazil, also at 2.5%.

COST SHARING FOR MRE

Mr. STOKES. The committee has insisted upon certain international cost-sharing requirements. Have these requirements been met?

Dr. HARRIS. Yes, sir.

Mr. STOKES. The agreement between the United States and its international partners with regard to Gemini has been of interest to the subcommittee. Could you explain some of the requirements made under the agreement? Was this the one where you still don't have the MOU?

Dr. HARRIS. I think that we are—I am not sure if I understand the question, sir.

Mr. STOKES. We are talking about items over and above the cost sharing in the agreement between the international partners; were there other requirements?

Dr. HARRIS. I am not aware of other requirements at this time. When you build the telescope, you will be able to measure and do astronomy. Ultimately, you will have operating costs that will be shared by the countries as well.

OPERATIONAL COSTS FOR GEMINI

Mr. STOKES. OK. We note that the operational costs are estimated to be $9 million per year to be shared by all the international partners. Do you expect these costs to increase in the future?

Dr. HARRIS. That estimate sounds to me to be low from what I know about these astronomy facilities. I would like to confirm that for you and get more current data. My rule of thumb is that these often cost about 10 percent of the construction figures, and you are talking about roughly a $200 million telescope, so I would have guessed it to be a little more than that, but I would like to confirm that number for you.

Mr. STOKES. Sure.

[The information follows:]

OPERATIONAL COSTS FOR THE GEMINI 8-METER TELESCOPES

Our preliminary estimate of the operating costs for the Gemini telescopes is $10.6 million per year, of which the U.S. would provide 50%. This is based on an operational model in which the operations in Hawaii are combined with those of the Joint Astronomy Center (which operates the United Kingdom Infrared Telescope and the James Clark Maxwell Telescope, both Mauna Kea) and the operations in Chile are combined with those of the Cerro Tololo Inter-American Observatory. Sharing of manpower, physical plant, and other resources will result in considerable savings over a stand-alone operation. These models (particularly the requirements for continuing facility and instrumentation upgrades) will be reviewed as the telescopes approach operational status. While some increase may be necessary, we do not expect that the total would exceed 10% of the construction costs.

MIRROR SELECTION FOR GEMINI

Mr. STOKES. At last year's hearing, we discussed the mirror selection process for the Gemini telescopes. At the time of the hearing, Dr. Harris said there was a full engineering design review for the mirror that was expected. Can you give us a brief update on that?

Dr. HARRIS. Yes, sir. That was completed this past November, and the Corning mirror, if you like, the meniscus mirror passed the preliminary design review and the second mirror blank has been ordered for both telescopes now.

ACADEMIC RESEARCH INFRASTRUCTURE

Mr. STOKES. Let's now turn to academic research infrastructure. Dr. Lane, I have heard several estimates for the cost of modernizing academic facilities. I understand there is quite a backlog of facilities that need to be upgraded. What is the current cost estimate to deal with these facilities?

Dr. LANE. Well, Mr. Chairman, I think I heard numbers from $7 to $10 billion, maybe some numbers even slightly larger than that. We expect to have an updated estimate of these needs soon. Can I get a date on that? Do you know when we will have that report?

Dr. PITTS. The NSF report is due out in September.

Dr. LANE. Thank you.

That is Dr. Nat Pitts, who runs this program.

Mr. STOKES. Tell us why you have chosen to fund this program at the same level as requested in fiscal year 1994.

Dr. LANE. Mr. Chairman, the academic research infrastructure is a high priority with us. We recognize the need is real, and I agree with you, Mr. Chairman, in your comments in communication with Mr. Brown about the importance of a program, a Merit Review Program, such as NSF has, to try to help renovate and replace where necessary the facilities out in the universities. Because it is needed and also because it helps eliminate earmarking which had come to be a practice. So it is a high priority with us, but in a tight budget year and given that the NSF really on its own can't hope to address the larger issue, I felt this was appropriate for us to request. It was a hard decision.

It has been our feeling all along that this is an area where many agencies should work together. All agencies that support academic research, we feel should participate in a multi-agency, government-wide program.

And I have written the President's Science Advisor, Dr. Jack Gibbons, asking that this be an important agenda item on the council agenda. And the fundamental science research committee that I chair with Dr. Harold Varmus, Director of NIH, and Associate Director, Dr. Marcy Greenwood, will take this on as an important topic for discussion. And we hope to make some progress in addressing this on a government-wide basis.

REPORT ON TACKLING FACILITY AND INSTRUMENTATION NEEDS

Mr. STOKES. Dr. Lane, the Senate directed that a strategy be developed to be submitted concurrently with the 1995 budget submission to tackle the facility and instrumentation needs in a comprehensive fashion. What is the status of that report? When will it be completed?

Dr. LANE. Mr. Chairman, our response to the subcommittee is to indicate the desire to make this a multi-agency initiative and to work through the President's new National Science Technology Council to that end.

SALARIES AND EXPENSES

Mr. STOKES. Let's turn to the salaries and expense account. You are requesting $130,700,000 and 1,243 FTEs for salaries and expenses in 1995. According to the justification, this represents an increase of about $12.4 million, and 40 FTE above the 1994 levels.

In the justification on page 72, you indicate a decision not to fully fund the authorized employment ceiling of 1,203 FTEs in 1994. What FTE level can be supported in 1994?

Dr. LANE. I would like to ask Mr. Joe Kull to respond to that.

Mr. STOKES. Mr. Kull.

Mr. KULL. Mr. Chairman, we are looking for about 1,180 FTEs funded in 1994. In terms of the authorized amount, you will come slightly below, it is about 23 or 4 below the authorized ceiling.

Mr. STOKES. So the total funding increase requested in 1995 for staff is for approximately 60 FTE rather than 40; is that correct?

Mr. KULL. We would like to see full funding of the 23 or so up to the 1,203 ceiling in 1994, and then the additional 40 FTEs in 1995.

TRAVEL COSTS

Mr. STOKES. The Foundation is requesting $3,490,000 for travel in 1995. That is about a 50 percent increase above 1993 level. Tell us why travel costs increase by 50 percent over a two-year period?

Mr. KULL. Well, travel is extremely important to our program managers in their ability to do oversight of the programs that they administer. We currently plan on spending about $3 million in 1994, so the increase is $500,000, that is about a 15 percent increase over the 1994 level.

So I don't understand where the 50 percent increase is coming. The 1993 actuals were something like $2.3 million.

Mr. STOKES. It is based on the two-year period we are talking about.

Mr. KULL. Okay. Again, the problem is that we were very low in 1993, our budget only increased $1 million in 1993 over 1992. Travel is a variable cost and it was depressed in 1993.

Our normal expenditures are about in the $2.7, $2.9 million range; so unfortunately, 1993 is a very low year to compare to.

Mr. STOKES. In terms of travel, are we talking about an increase due to travel costs increasing or the number of trips that will increase or both?

Mr. KULL. Well, the costs of travel are slightly up, but I think we are looking at getting our program officers out in the field a lot more to do the other oversight on our programs and their awards.

Dr. LANE. Mr. Chairman, could I add a comment on this; because it is an area that I am worried about? Because the way we make decisions and the way we monitor projects is by having Ph.D. scientists, mathematicians, engineers at the NSF to make. And so while peer review is a very important part of our decision-making apparatus, the judgment of the program officers is absolutely key to ensuring that these funds are invested wisely. So if we cannot get our people out to make the site visits, especially facilities and centers which we have a lot of, that disadvantages us.

And I already know from my short time at the NSF that our people are having difficulty being able to make the sufficient number of visits to monitor these projects. So it is an issue that we are going to look at hard as a part of our internal operations review, because it is an area of some concern to me.

Mr. KULL. Mr. Chairman.

Mr. STOKES. Yes, sir, Mr. Kull.

Mr. KULL. I would like to add, going back to travel in 1992, I mentioned 1993 was a low year because of our funding. Our 1992 actual was over $2.9 million. So you could see the request for 1995 is not that far out of line when comparing 1992 to 1995.

Mr. STOKES. Okay.

NSF EMPLOYMENT

Dr. Lane, let's discuss employment for a few moments. The subcommittee requested information on NSF employment. That information was broken down between male and female for nonminorities, blacks, Hispanics, Asians and African–Americans, American Indians and disabled. We will place those tables covering 1992 and 1993 in the record at this point.

[The information follows:]

NATIONAL SCIENCE FOUNDATION EMPLOYMENT

Tables detailing NSF employment in FY 1992 and FY 1993 follow:

NATIONAL SCIENCE FOUNDATION
EEO PROFILE GRADES 1-15 AND SES AS OF 9/30/92

		TOTAL		WHITE		BLACK		HISPANIC		ASIAN		AM. IND		*DISABLED STAFF	
	All	M	F	M	F	M	F	M	F	M	F	M	F	TOTAL/TARGETED	
SES															
Permanent	104	90	14	78	14	6	0	2	0	4	0	0	0	3	1
Temporary	3	1	2	0	1	0	1	1	0	0	0	0	0	0	0
GRADE 15															
Permanent	74	52	22	49	20	2	1	0	0	1	1	0	0	2	0
Temporary	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GRADE 14															
Permanent	86	44	42	36	36	7	4	0	0	1	2	0	0	6	0
Temporary	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GRADE 13															
Permanent	76	30	46	23	30	6	14	1	2	0	0	0	0	5	0
Temporary	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GRADE 12															
Permanent	78	27	51	20	30	6	20	0	0	1	1	0	0	2	0
Temporary	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GRADE 9-11															
Permanent	128	21	107	14	46	3	55	2	2	2	4	0	0	3	0
Temporary	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0
GRADE 1-8															
Permanent	405	61	344	18	74	40	258	1	4	2	7	0	1	20	7
Temporary	28	10	18	1	1	9	17	0	0	0	0	0	0	2	0

*The "TOTAL" for persons with disabilities includes all persons who have identified themselves as having a disability. The term "TARGETED" disability refers to persons with severe disabilities.

NATIONAL SCIENCE FOUNDATION
EEO PROFILE OF UNGRADED STAFF[1] AND IPA'S AS OF 9/30/92

		TOTAL		WHITE		BLACK		HISPANIC		ASIAN		AM. IND		[2]DISABLED STAFF	
	All	M	F	M	F	M	F	M	F	M	F	M	F	TOTAL/TARGETED	
STEP 5															
Permanent	4	3	1	3	1	0	0	0	0	0	0	0	0	2	0
Temporary	3	2	1	2	1	0	0	0	0	0	0	0	0	1	0
STEP 4															
Permanent	160	127	33	112	29	4	3	2	1	9	0	0	0	17	4
Temporary	75	55	20	51	16	0	3	1	0	3	1	0	0	3	1
STEP 3															
Permanent	17	11	6	10	6	0	0	0	0	1	0	0	0	1	0
Temporary	16	8	8	6	6	1	0	0	1	1	1	0	0	0	0
STEP 2															
Permanent	8	3	5	3	5	0	0	0	0	0	0	0	0	0	0
Temporary	5	2	3	1	3	0	0	0	0	1	0	0	0	0	0
STEP 1															
Permanent	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0
Temporary	5	2	3	1	2	0	0	0	0	1	1	0	0	0	0
IPA	78	61	17	53	14	3	2	1	1	4	0	0	0	5	0

[1] Steps 1 - 5 represent employees with Grade 0 and pay plan 'AD' (including Rotators).

[2] The "TOTAL" for persons with disabilities includes all persons who have identified themselves as having a disability. The term "TARGETED" disability refers to persons with severe disabilities.

NATIONAL SCIENCE FOUNDATION
EEO PROFILE GRADES 1-15 AND SES AS OF 9/30/93

		TOTAL		WHITE		BLACK		HISPANIC		ASIAN		AM. IND		*DISABLED STAFF	
	All	M	F	M	F	M	F	M	F	M	F	M	F	TOTAL	TARGETED
SES															
Permanent	99	85	14	73	14	6	0	2	0	4	0	0	0	3	1
Temporary	3	2	1	2	0	0	1	0	0	0	0	0	0	0	0
GRADE 15															
Permanent	81	58	23	53	22	4	1	0	0	1	0	0	0	4	0
Temporary	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GRADE 14															
Permanent	86	43	43	36	35	6	6	0	0	1	2	0	0	5	0
Temporary	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0
GRADE 13															
Permanent	75	28	47	22	30	5	15	1	2	0	0	0	0	6	0
Temporary	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GRADE 12															
Permanent	76	28	48	20	25	6	21	1	1	1	1	0	0	1	0
Temporary	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GRADE 9-11															
Permanent	139	24	115	16	49	5	62	1	1	2	3	0	0	2	0
Temporary	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0
GRADE 1-8															
Permanent	383	52	331	14	69	36	251	0	4	2	7	0	0	20	7
Temporary	20	7	13	1	2	6	11	0	0	0	0	0	0	0	0

*The "TOTAL" for persons with disabilities includes all persons who have identified themselves as having a disability. The term "TARGETED" disability refers to persons with severe disabilities.

NATIONAL SCIENCE FOUNDATION
EEO PROFILE OF UNGRADED STAFF[1] AND IPA'S AS OF 9/30/93

		TOTAL		WHITE		BLACK		HISPANIC		ASIAN		AM. IND		[2]DISABLED STAFF	
	All	M	F	M	F	M	F	M	F	M	F	M	F	TOTAL	TARGETED
STEP 5															
Permanent	7	5	2	5	2	0	0	0	0	0	0	0	0	3	0
Temporary	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0
STEP 4															
Permanent	164	122	42	108	34	4	5	1	2	9	1	0	0	13	3
Temporary	44	29	15	28	13	0	2	1	0	0	0	0	0	1	0
STEP 3															
Permanent	22	16	6	14	6	1	0	0	0	1	0	0	0	1	0
Temporary	7	3	4	2	4	0	0	0	0	1	0	0	0	0	0
STEP 2															
Permanent	6	3	3	3	3	0	0	0	0	0	0	0	0	0	0
Temporary	4	1	3	1	3	0	0	0	0	0	0	0	0	0	0
STEP 1															
Permanent	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0
Temporary	5	2	3	1	2	0	0	0	0	1	1	0	0	0	0
IPA	127	100	27	81	16	5	5	4	3	10	3	0	0	10	2

[1] Steps 1 - 5 represent employees with Grade 0 and pay plan 'AD' (including Rotators).

[2] The "TOTAL" for persons with disabilities includes all persons who have identified themselves as having a disability. The term "TARGETED" disability refers to persons with severe disabilities.

MINORITY EMPLOYMENT AT NSF

Mr. STOKES. According to the tables, minorities represent about 40 percent of total NSF employment, as of September 30, 1993. This is a slight increase above 1992. Of that 40 percent, African-Americans are approximately 34 percent, Hispanics comprise 2 percent, Asians comprise about 4 percent; is that correct?

Dr. LANE. I will have to verify that.

Mr. Kull or Mr. Cota-Robles?

Dr. COTA-ROBLES. It is correct.

MINORITIES IN THE SES

Mr. STOKES. However, minorities only make up about 13 percent of the SES; and African-Americans only make up about 6.9 percent; a total of 7, 6 males and 1 female. And of course, Dr. Lane, we realize you haven't been there very long to pose these questions to, but someone should be able to answer some of these questions for us.

How do you explain the low percentage of African-Americans in NSF's SES service?

Dr. LANE. Well, Mr. Chairman, this is an issue that is a serious one at NSF. I know from the short time I have been there, my discussions with Dr. Bernthal who was Acting Director before I came and with Dr. Cota-Robles, who is Special Advisor to the Director of Equal Employment Opportunities and was in that position for Dr. Massey before I arrived. It is an issue that has had a great deal of focus. And I would like in just a moment for Dr. Cota-Robles to comment on this.

I do want to point out, we see some good news and we see some disappointing news. We see that SES positions held by women are up by a factor of 2, from 7 to 14 in five years. The number of women in permanent positions, scientists or engineers, is up from 70 to 92, that is 30 percent in five years. Two of our assistant directors, who run the directorates of the organization, are women, and two are African-Americans. But our total minority representation, as you point out Mr. Chairman among 343 scientists and engineers, is still far too low.

My record shows 22 African-Americans and 5 Hispanic. I think that is probably a current number, but I would like to ask Dr. Cota-Robles to elaborate on that.

Dr. COTA-ROBLES. That is a current number.

Mr. STOKES. Your table is as of 9/30/93; right?

Dr. LANE. So we didn't really answer your question, Mr. Chairman.

Mr. STOKES. No, you have not.

Dr. LANE. Dr. Cota-Robles, would you like to comment on that?

Dr. COTA-ROBLES. I think one of the important reasons, too, is that the bulk of the senior appointees at the Foundation are scientists and engineers. And we know from the efforts that we have talked about in education and human resources that it is a situation of human resource development. I think that the key issue is not only to get people through the pipeline, but to have them achieve principal investigator status in science and engineering. And that is where I think we have made some progress recently.

Certainly, for women we made significant progress in principal investigators, and for minorities we are in the process of increasing that. But it is still low. We are talking about starting from a very low level and now principal investigators that are minorities are probably 500 individuals out of 9,000 grants. So that is a low proportion and until we get more of those individuals to be principal investigators, we will not have individuals who will have the kind of powerful credentials that we want as division directors or other SES scientists.

MINORITY EMPLOYMENT STRATEGY

Mr. STOKES. I guess that is what I really want to get at. Could you explain to me how we ever get to that point? Do we have some type of plan or strategy?

You mentioned a pipeline, and obviously the type of things that we discussed here earlier with Dr. Williams, we understand. New initiatives, and so forth. But how do we ever get them up into the divisions where it would be reflected in these figures?

Dr. COTA-ROBLES. The typical age, I guess, would be 40 to 45 is when an individual would be a division director, and so if they finish their doctorate at 30, they have to develop their careers over the next 12 or 15 years. So that is a real time frame that we have to deal with.

In some cases, by using the rotators, we are able to bring in people into the Foundation at an earlier level, but I think the most important way is through having them participate on our peer review panels, to become more expert and more well-known in the scientific community. And we are seeing an increase in that, serving on advisory committees, but on the peer review panels is the key.

Principal investigator, practicing scientist, is then into the area of serving on peer review panels, and then becoming an individual that can be recruited. We are developing databases and things of that sort, but in many ways, without the kind of experience that Dr. Williams and I had as microbiologists before we came to NSF, we would not have been able to have the impact that we have had. So it is a practicing scientist I think is really crucial.

Dr. LANE. Mr. Chairman, shortly after I came, I established an Equal Employment Opportunity Task Group within the NSF, asking my deputy director to chair that group. And Dr. Cota–Robles when he arrived was willing to join that group as vice-chair. That activity is to look inside the Foundation and outside and to help put together a strategy such as we are talking about here today.

And some of the things that Dr. Cota–Robles is talking about are recommendations that are going to be coming along to me soon as this committee reports its activities. It is a broadly based committee, folks from all levels within the Foundation, including program people who understand some of the problems that faculty face and students face when they are thinking about careers.

It is, of course, terribly unfortunate that Ph.D.s are facing this terrible job problem at a time when we want to encourage, continue to encourage bright young people from all backgrounds and who are capable of working in professions in science and engineering, we want to encourage them to do so. And the employment problem has made that difficult.

But my expectation is that we will have a strategy that will help us make some progress in all of these areas.

Mr. STOKES. Well, I would hope so. During the time that I have sat on this subcommittee, I have seen two of the directors appear before us here who were African–Americans. And so they must exist out there. I wouldn't think Dr. Williams is in isolation of his field. So it seems to me some type of strategy ought to be adopted here that can alleviate what I think all of us would agree is not a very good situation.

Dr. LANE. I agree, Mr. Chairman. We have long been talking about excellence. And sometimes then we became conscious of excellence with diversity or excellence, some people would even say excellence or diversity. And I think it is long past the time we talked that way. I think the increasing realization is that excellence in itself is going to mean representation from all our community. And we will do everything we can to try to find a way to make some progress on what is a very important issue for the science and engineering enterprise, but also for the country.

EMPLOYEE CLASSIFICATIONS

Mr. STOKES. I appreciate that and we will certainly look forward to seeing what progress is made in that area.

Let me ask you this: NSF also has two other employee classifications, ungraded and IPA. Can you explain those classifications to the subcommittee?

Dr. LANE. Well, the IPA is a classification of employee, generally a faculty member comes from the university for two or three years and remains an employee of the university. The Federal Government reimburses the university for the faculty member's salary and the faculty member spends full time at NSF doing the jobs that our permanent employees do as program directors or even division directors, really at any professional level in the Foundation. The ungraded employees, I will ask Joe Kull to comment on.

Mr. KULL. Those are the scientists and engineers that come in and are Federal employees that are paid on what is known as an administratively determined basis. We actually determine their salaries in advance so that they don't fall into the regular GS scale. There are five pay grades within those determined levels, ranging from about a GS–9 through 12, up through a GS–15.

Mr. STOKES. Are ungraded and IPA classifications mostly comprised of program managers and other professionals?

Mr. KULL. Yes, sir.

EMPLOYMENT OF UNGRADED AND IPA STAFF

Mr. STOKES. Can you explain why as of September 30th, 1993, the date of these tables, only 4.5 percent of the ungraded staff and 7.8 percent of the IPA staff were African–Americans?

Mr. KULL. I think it is the same explanation as Dr. Cota–Robles and Dr. Lane were talking about. It is what is available in the pipeline and the competition for those types of people.

Dr. LANE. Mr. Chairman, could I just add a comment that I should have made earlier?

That Dr. John Hopps is an IPA with us this year. He is the first African–American Division Director in MPS. He is a Director of the Division of Materials Research, working with Bill Harris who is Associate Director in that area. And I would also mention that Shirley Malcom has been nominated by the President to serve on the National Science Board.

Mr. STOKES. Okay.

We have a few more questions along the same line, Dr. Lane, that we will submit for the record. If you will provide good answers for us, we would appreciate it very much.

Dr. LANE. We will try our best, Mr. Chairman.

[Questions and answers for the record are included immediately following the transcript materials.]

CLOSING REMARKS

Mr. STOKES. Well, we want to recognize you at this time for any concluding remarks that you would like to make.

Dr. LANE. Thank you, Mr. Chairman. I will be very brief.

I appreciate the opportunity, we appreciate the opportunity to appear before you today. Earlier you asked if I would address a vision for the NSF, and I think what I said is that we would continue to focus on excellence, but we would look for ways to be more efficient, more effective, and perhaps more responsive to the Nation's needs.

I should have added at that time, that with the realistic budget constraints that we foresee as we work together to reduce the deficit, priorities are not only going to be important, as they always have been, but they are going to be very difficult. And I would argue that the budget we bring to you this time reflects hard choices among high priorities.

The academic research infrastructure is a high priority for us. We believe it is a multi-agency responsibility. We would expect to continue to play an important role and we believe we bring to the table a record of merit review of proposals that is going to be very important in seeing that such a program is successful. Education, human resources development, also a very important priority with us. It is an area that has seen substantial growth over recent years until it is now on the order of 20 percent of the budget of the Agency.

Our focus in 1995 is on evaluating the programs to see if we can make them better, more effective, but that area is at the core of what the NSF does and will continue to be.

Finally, in research, difficult decisions. We focused on strategic areas and we folk focused in particular on a few strategic areas where we feel that NSF can bring to bear on these national societal priorities the best of the scientists, engineers and mathematicians who can work in these areas, and we will try to support them well.

Finally, I will argue NSF has an outstanding staff. I knew that before I came. I am so pleased to say there are no surprises in that regard. NSF works at a fairly low overhead in terms of its operating expenditures, so I think it is efficient and I believe it is recognized as being efficient, and that is one reason we were supported for an increase of 40 FTE in our staffing.

So in summary, Mr. Chairman, I would say that the budget request reflects hard choices that reflect the priorities of the Foundation and of the administration.

I thank you very much for the hearing today.

Mr. STOKES. Well, thank you very much, Dr. Lane.

I think we have had a good hearing. We have covered a broad part of your budget submission, along with the answers you are going to provide for us to some other things, I think that we have made a good record here today.

Dr. LANE. Thank you, sir.

Mr. STOKES. I appreciate your attendance and that of all your associates and the testimony all of you have given us.

Thank you very much.

Questions Submitted for the Record
by
Congressman Louis Stokes

QUESTION: Over the past year, there has been quite a bit of discussion on strategic areas and initiatives and so forth. What is your definition of "strategic"?

ANSWER: Strategic research areas are those areas in which a concerted research effort can be expected to provide discoveries that will be useful in helping meet goals of broad national importance. These strategic areas, often encompassing a number of science and engineering disciplines, can be thought of as areas in which science and engineering intersects with the public interest and national priorities. For example, three such strategic areas currently supported by the Foundation are research on the Environment, Global Change, and High Performance Computing and Communications. Fundamental research in all of these areas will contribute to the national priority for protecting the environment.

Basic research by definition can have unexpected results. For example, research in atmospheric chemistry might not have been considered "strategic" by some a decade ago, before the unforeseen discovery of the Antarctic ozone hole. It is important, therefore, that other research areas are also supported in order to maintain a balanced program, to allow for unexpected discoveries, and to seize new opportunities.

QUESTION: Are "strategic areas" synonymous with national priorities?

ANSWER: Research in strategic areas contributes to, but is not necessarily synonymous with, national priorities. Strategic research areas as defined by the National Science and Technology Council (NSTC) are clearly connected to national priorities. Investments in these areas, along with related education and training activities, will yield knowledge useful in making progress toward national goals. For example, one such national priority is long-term economic growth to create high quality jobs. Areas of strategic research funded by NSF and other federal agencies which will contribute to this national priority include research in advanced materials, manufacturing technologies, and high performance computing.

Congressman Louis Stokes

QUESTION: According to your testimony, more than 75 percent of the incremental increase will be for research and education in certain strategic areas.

Are these initiatives and their funding levels the same as requested of OMB? Please provide the amounts requested.

ANSWER: The following table provides NSF's request for research in strategic areas:

NATIONAL SCIENCE FOUNDATION
FY 1995 BUDGET REQUEST
(dollars in millions)

RESEARCH IN STRATEGIC AREAS	
Advanced Manufacturing Technology	$196
Advanced Materials and Processing Program	$313
Biotechnology	$206
Civil Infrastructure Systems	$54
Environmental Research including Global Change	
US Global Change Research Program	$208
Environmental Research	$156
High Performance Computing and Communications	$329
Science, Math, Engineering and Technology Education	$650

The request to Congress was mutually agreed upon by OMB and NSF in an iterative process based on bottom-line guidance from OMB to the Foundation.

QUESTION: How much of the agency's budget is considered "investment" by the Administration?

ANSWER: All of NSF's research and education activities are considered "investment" by the Administration. This includes about 96% of the entire NSF budget--everything except for the Salaries and Expenses, NSF Relocation and the Office of Inspector General appropriation accounts.

QUESTION: Will the large increases requested in the strategic areas be slowed in the future to review their progress and to review the need for consolidation the way the science and math education activity is being slowed this year?

ANSWER: Future plans for the strategic areas are being addressed as part of the current strategic planning process.

QUESTION: In FY 1992, the Appropriations Committee directed NSF to produce a plan to integrate EPSCoR with similar programs from other agencies into a unified Federal effort. At last year's hearing, we discussed a draft memorandum of understanding

outlining the terms of interagency cooperation. According to Dr. Massey the MOU had not yet been signed. (p. 80) Has the MOU been completed and signed?

ANSWER: The MOU was reviewed by all agencies with EPSCoR and EPSCoR-like programs and signed in May 1993 by five of the seven participating agencies: Department of Energy (DOE), Environmental Protection Agency (EPA), National Aeronautics and Space Administration (NASA), National Science Foundation (NSF), and U.S. Department of Agriculture (USDA). The Department of Defense (DOD) and National Institutes of Health (NIH) chose not to sign, because they believe that interagency cooperation can be accomplished without an MOU.

QUESTION: **According to Dr. Williams, at last year's hearings, an agreement had yet to be reached with regard to non-Federal matching requirements -- what kind of agreement was reached?**

ANSWER: The National Science Foundation commissioned a study to be done by COSMOS Corporation on non-federal matching requirements. The preliminary results of the study are expected to be available late this Fall.

While awaiting the results of the study, the agencies have informally agreed as to how they will handle the non-federal matching requirements on an interim basis. NSF, DOE, and EPA have all agreed to require a dollar-for-dollar match from non-Federal sources. NASA and USDA have agreed to varying the "match" requirements as is appropriate to their different programs.

QUESTION: **Under the agreement, NSF will act on behalf of all agencies in assessing EPSCoR outcomes. Has a method for evaluating the outcomes of EPSCoR been established? (If not, when?)**

ANSWER: NSF expects to make an award for the evaluation of EPSCoR programs around July of this year. The evaluation will be overseen by the Research, Evaluation and Dissemination (RED) division of EHR. The expectation is that the evaluation will take 24 - 27 months and will focus on NSF's program, because of its longevity, yet will also examine all EPSCoR programs operating in each state. Preliminary data should be available at the end of the summer 1995.

The evaluation will be pulling together the work that has been done by three contracts supported by NSF over the past two years. The contracts have provided the groundwork for the evaluation by collecting data, designing and implementing the EPSCoR data system and developing criteria for assessing competitiveness and its progress over time.

QUESTION: **According to the justification, in 1993 NSF conducted a reorganization and expansion of the Model and Experimental Programs for Women and Girls, and the program for Persons with Disabilities was established. Could you tell us how and why those changes were made?**

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ANSWER: The original Career Access Program at NSF had a modest Model Projects component, but only 11 percent of the funds for that component in the years 1988-1992 went to projects for women and persons with disabilities. Most of the funding support for Career Access was targeted toward minorities and there was little public awareness focused on the efforts of these two other targeted populations. Thus, it was critical that greater attention and support be provided to increase the representation of women and persons with disabilities in SEM fields, and for improving their scientific literacy.

In an increasingly technology-oriented society, a basic understanding of science and mathematics is essential to the preparation and maintenance of a technically competent work force for this Nation. Demographic trends indicate that new entrants into the work force will be comprised of increasing numbers of women, persons with disabilities and other groups who are underrepresented in science and engineering. According to the U.S. Department of Labor, report, *Workforce 2000*, between now and the year 2000, nearly two-thirds of new entrants into the work force will be women, and, by the same year, nearly two-thirds of working age women will have jobs. Moreover, the jobs facing these new workers will require higher skill levels in science, engineering and mathematics (SEM) than ever before.

Several issues are of particular concern relative to women, who are significantly underrepresented in the physical sciences, mathematics, and engineering, included are the following:

- the disproportionately high numbers of girls who lose interest in science during elementary and middle school;
- the low numbers of women who enroll in college-prep science and math courses in high school;
- the disproportionately low numbers of women entering undergraduate studies in SEM, particularly in the physical science, computer science, and engineering;
- the current low numbers of women completing SEM degrees at all levels; and
- the slow rate of women's advancement to senior rank and other leadership positions.

To reverse these trends, changes are needed. At the elementary and secondary levels, there must be significant changes in the ways science and math are taught to insure inclusion and participation of girls and young women, and persons with disabilities. This includes changes in the formal and informal interactions that support and develop their interest, understanding, and skills in science and mathematics. At the colleges and universities there must be changes in the cultures of SEM departments to improve the recruitment and retention of women and girls, and persons with disabilities, in SEM studies and careers. At all levels, there are barriers to participation for these populations that need to be addressed, especially physical ones for persons with disabilities.

The following activities are part of the Programs for Women and Girls (PWG) and Persons with Disabilities (PPD) components:

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1. **Model Projects**, which encourage the design, implementation, evaluation, and dissemination of innovative, short-term, highly focused activities which improve access and/or retention of the target populations in SEM education and careers;

2. **Experimental Projects**, that support activities which create positive and permanent changes in the academic, social, and scientific climates which allow the interest and aptitudes of the target populations in SEM to flourish. This effort also supports projects which add to the knowledge base regarding interactions between gender or disability and the infrastructure of SEM.

3. **Information Dissemination Activities** accelerate efforts to increase the participation of these populations in SEM by encouraging widespread dissemination of information and strategies. This program supports activities which inform others of successful strategies which improve participation of or reduce barriers to these populations in SEM.

QUESTION: Have these programs improved the participation rates of these groups?

ANSWER: Our first year of operation is just being completed with these expanded program efforts, therefore, we have no real baseline for comparison. However, within two months after the initial program announcement for Model Projects for Women and Girls, there were 62 proposals submitted. Funds were available for 15 Model Project awards for women and girls in FY 1993, in comparison to 27 awards to investigators in the previous five-year period under Career Access. For the first Experimental Projects for Women and Girls competition, nearly 200 preliminary proposals were submitted and reviewed. Subsequently, 61 formal proposals were received for this program. The funding for the three EHR programs for women and girls in FY 1994 is nearly double what was spent on programs for this population in the first five years of Career Access. Of considerable interest is the fact that a substantial number of institutions submitting proposals for women and girls programs had not previously dealt with NSF, so we are broadening both the numbers and types of groups attempting to participate in addressing a difficult problem.

QUESTION: On page 224 of the justification, it states that the Evaluation program will increase by 14.5 percent to a total of more than $10,000,000. At last year's hearing, we discussed the evaluations that were underway. Could you briefly describe the findings of the evaluation of math/science education programs as well as any results from the evaluations underway in the K-to-12 programs?

ANSWER: Prior to FY 1992, there was no formal schedule of program evaluations. Since the program has been initiated, NSF has completed evaluation of the Visiting Professorships for Women and the Undergraduate Faculty Enhancement program. Reports from these evaluations have been submitted only recently and have not yet undergone formal management review. However, both of these third-party evaluations concluded that the programs were very effective in meeting their fundamental goals. We are not expecting that significant changes will result from either evaluation.

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The FY 1995 budget request for evaluation the Research, Evaluation and Dissemination (RED) division of EHR is in response to the June 1993 FCCSET report, "The Federal Investment in Science, Mathematics, Engineering, and Technology Education: Where Now? What Next?" This report identified 300 core science, mathematics, engineering, and technology (SMET) education programs in the federal agencies. It further showed that the vast majority of them have neither been evaluated nor are being monitored in the agencies which manage those programs. As a result even baseline data on the performance of core SMET education programs are lacking.

NSF recognizes the need to demonstrate how education programs are having intended effects with teachers, students, and entire school systems. NSF's request for more resources and staff is for the purpose of accelerating the number and pace of education program evaluations within NSF.

QUESTION: The justification states that 12 new evaluations will begin in FY 1994. What kind of evaluations will be conducted this year? Are they underway?

ANSWER: Currently, six evaluations are underway, including a multiyear evaluation of the SSI program. Between now and early FY 1995, we will start six more. We will also do a set of smaller, focused "impact studies" of programs such as Young Scholars, Presidential Awards for Excellence in Science and Mathematics Teaching, and Research in Teaching and Learning. As these evaluations and impact studies are completed, they will be reviewed by a committee of senior management in EHR which will recommend actions based on the findings. The schedule is provided:

Congressman Louis Stokes

EHR PROGRAM EVALUATION SCHEDULE, FY 1994-95

Revised 3/9/94

Division	FY94	FY95
DUE	*Undergraduate Course and Curriculum Instrumentation and Laboratory Improvement Collaboratives for Excellence in Teacher Preparation (**p**)	Advanced Technology Education (administered jointly w/ESIE) (**p**)
ESIE	Informal Science Education Instructional Materials Development (**p**)	----
GERD	----	Presidential Faculty Fellows (**p**)
HRD	*Research Improvement in Minority Institutions/ Minority Research Centers for Excellence Alliance for Minority Participation/ Research Careers for Minority Scholars (**p**)	Partnerships for Minority Student Achievement/Comprehensive Regional Centers for Minorities Summer Science Camps (**p**)
OSR	*EPSCoR *Statewide Systemic Initiative	Urban Systemic Initiative
RED	*FCCSET Assessment of Federal Laboratory Capacity for Teacher Enhancement FCCSET Evaluation of Teacher Enhancement Programs	Studies & Indicators Applications of Advanced Technologies

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* under way and continuing from FY 1993
p planning to begin in year indicated, not actual evaluation

Note: Excluded from above are "impact studies" of program processes and outcomes, but more limited in scope than full-blown evaluations.

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QUESTION: I note that the Long-Term Ecological Research sites are considered a significant component of this activity and according to page 85 of the justification, the requested increase for these sites is more than 36 percent.

Why are these particular centers receiving such a large increase?

ANSWER: NSF's network of Long-Term Ecological Research (LTER) sites has contributed strongly to the US efforts in Global Change Research. The teams involved in LTER have put in place experiments and established long temporal data bases that will be increasingly valuable in answering questions on changes in the Earth's plant and animal populations, mineral nutrient cycles, and the ability of critical ecosystems to sustain themselves and humankind.

The increase requested for LTERs will support an expansion of the scope of the LTER effort. Participation by other science and science education disciplines will be incorporated into the existing network of LTER projects, large-scale and cross-site information syntheses and mathematical modeling efforts will be enhanced, and international research collaborations will be established. The net effect of this increase will be to strengthen our ability to extrapolate research findings beyond the ecosystems being directly studied and to provide us with predictive power with regard to the reaction of ecosystems to proposed changes in environmental policy and practice.

QUESTION: For the past several years, NSF has worked closely with the Agency for International Development and the NIH on a joint research program in the area of biodiversity. Can you provide us with the status of this effort?

ANSWER: The National Science Foundation (NSF) and the US Agency for International Development (USAID) have been participating for several years in a Cooperative Agreement for Research in Biodiversity. Each year, proposals are jointly reviewed by the two agencies as described in a recently published brochure entitled Joint International Research Opportunities in Biodiversity. Awards made under NSF's peer review system are supplemented by funds "passed through" by USAID to improve the capabilities of a host country to do research concerning conservation of biological diversity and to develop sustainable use of biotic resources with potential benefit to the host country economy. The first supplemented awards under this cooperative agreement were made in FY 90 and, to date, over 50 projects involving research in 21 different countries have received support. Both agencies are enthusiastic about this cooperative agreement and it has been viewed as a model system for interagency research activities.

This three agency program is relatively new. Proposals submitted in competition for the NSF/NIH/USAID International Cooperative Biodiversity Groups were reviewed in the spring of 1993 with five awards being made. Each award is of five years duration and collectively amount to $2.5 million per year. The first awards began on 30 Sept. 1993, so the research projects that are funded are just getting underway. As yet, we do not have any plans to expand beyond the initial five projects.

QUESTION: How do the Agencies work to carry out this program and do you believe this arrangement is a good model for other interagency research activities?

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ANSWER: All three agencies participated in the peer review and award recommendation process, including the final decisions on which projects were to receive support. The five funded projects are administered through the Fogarty International Center, the international arm of the NIH. Each project has an associated Technical Advisory Group which consists of representatives from each of the three participating agencies.

The Group Leader, or scientist who is the Principal Investigator on each project, is responsible for submitting three quarterly reports and one annual report, thereby keeping the agencies well informed of progress. While the research for all five awards is in initial phases of development, thus far, the three participating agencies are very satisfied with the organizational structure and believe this to be a good model for interagency research activities.

QUESTION: The justification states that the FY 1995 request for the NSFNET is $46,160,000. Does this includes the entire cost of the NSFNET? Are other expenses for this network included elsewhere in NSF's budget.

ANSWER: All continuing, broad purpose NSF-funded networking infrastructure, including NSFNET, is funded through the single program element mentioned. Additional ad hoc activities involving networking which are targeted at special audiences or purposes and are primarily the responsibility of another activity would be funded by that activity.

QUESTION: On page 112 of the budget justification, $2,000,000 is for "regional affiliates." My understanding is that these funds would go to support local and regional supercomputing and communications expertise at a wide variety of institutions.
-- Is that correct?
-- Where are these local and regional centers and how will they be involved in the implementation of this initiative?

ANSWER: Metacenter Regional Alliances (MRAs) are intended to enhance the computing and communications expertise of a wide variety of organizations and individuals in the university, education, public and private sectors, to facilitate broad involvement in the emerging National Information Infrastructure (NII), and to contribute to the nation's ability to address Grand Challenge and National Challenge application problems. MRAs will complement, expand and strengthen existing Metacenter activities at the regional, state or local level. By stimulating Metacenter collaborations, Alliance awards will enhance ongoing activities so as to provide better and wider capabilities to the community.

Organizations eligible to apply for these awards include regional and state-supported high performance computing centers; research and educational consortia, and other organizations with a major focus on advanced computing, communications and education.

A recent program announcement describes opportunities for MRA's, and outlines the criteria in the merit review process. Decisions on awards depends on such criteria as potential that the proposed regional activity can serve as a model for a larger national effort; potential for technology transfer; and demonstrated experience and leadership in an aspect of HPCC technology, tools, or services.

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One recent step taken to facilitate participation is a workshop recently held at the North Carolina Supercomputer Center. This initiated discussion between prospective MRAs, and the NSF Supercomputer Centers in order to examine and clarify the respective needs and roles of each in the formation of the Alliances.

QUESTION: I note that on page 117 of the justification, the Design, Manufacturing, and Industrial Innovation Subactivity is receiving the largest increase within the Engineering activity --almost 20 percent--for fiscal year 1995, and most of this increase is for the Small Business Innovation Research Program (SBIR).

According to the justification (p.130), this level of funding, $42,310,000 is mandated by P.L. 102-564 which calls for at least two percent of extramural research funds to be devoted to this activity. There is a similar mandate for the Small Business Technology Transfer (STTR) program.

Do you believe two percent is the correct amount of extramural funds to be expended on SBIR ? Should it be higher or lower?

ANSWER: We believe the statutory level of two percent of extramural research for the SBIR Program is an appropriate level of support for the Foundation.

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QUESTION: The NSF funds both the Small Business Innovation Research Program as well as the Small Business Technology Transfer Program. Could you explain the similarities and differences in these two programs? Is there any duplication occurring?

ANSWER: The Small Business Technology Transfer (STTR) Program complements the existing Small Business Innovation Research (SBIR) Program. These two programs, however, differ in both objectives and design. The objective of the STTR Program, as mandated by Congress, is to stimulate the transfer of technology from research institutions to the marketplace via cooperative research with small business concerns. The SBIR Program exploits commercially promising ideas which originate in the small business community.

University involvement in SBIR projects, while common, tends to be in a minor consulting or subcontracting role. Under the STTR Program, however, researchers at universities or other research institutions are encouraged to play a significant intellectual role in the conduct of the cooperative research. NSF expects synergism in the cooperative research under the STTR Program. Thus, a team approach is required in which at least one investigator is employed by the small business concern and at least one investigator is employed by the research institution. In NSF's SBIR Program, there is no requirement for a research team.

In some other respects the SBIR and STTR programs are similar. For example, both programs involve a three phase process. Phases I and II involve federally funded research. Phase III involves the commercial application of the research funded in Phases I and II. NSF does not support Phase III activities in either STTR or SBIR.

Firms that participate in the SBIR program may also participate in the STTR Program. However, there is no known duplication in the research being funded under the STTR and SBIR programs.

QUESTION: One of the components of this Subactivity is the Engineering Research Centers. According to page 136 of the justification, 18 centers were in operation at the beginning of FY 1994 and it is expected that three to four new centers will be added during this fiscal year. Is that statement still true?

ANSWER: Yes, by August 1994, NSF should have established 21 Engineering Research Centers, an increase from the present total of 18 centers. The FY 1994 competition is underway and we expect to make recommendations for a set of additional centers by the late summer. Within this competition, we are recompeting three of the centers originally established in FY 1985. Since these three centers may or may not be successful in the recompetition, NSF may actually fund up to six centers.

QUESTION: The justification doesn't state how many additional centers maybe added in fiscal year 1995--how many centers are you currently anticipating to add?

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ANSWER: Depending on the results of a FY 1995 recompetition of the five centers established in FY 1986, the overall number of ERCs may remain the same or increase by as many as two. This increase in the number of centers is possible because if a recompeting ERC is successful, its budget is reduced to $2.0 M per year for five years. Given this budget strategy, funds will be released from these budgets to support the establishment of additional ERCs.

QUESTION: According to testimony by Dr. Bordogna last year, the NSF is trying to establish a total of 25 centers. Is that still the case?

ANSWER: Yes, 25 is the number of centers that was recommended in a National Academy of Engineering study.

QUESTION: Let's turn to the Geosciences activity -- which includes an increase of $39,000,000 or almost 10 percent above the 1994 level. One of this Activity's priorities is the U.S. Global Change Research Program. I know we have already discussed this issue briefly -- but what does NSF expect to accomplish that warrants such a large increase?

ANSWER: The large increases requested this year for global change (an increase of more than $65 million to a FY 1995 requested total of $207 million across NSF) are concentrated in five major areas. These were identified by the multi-agency U.S. Global Change Research Program (US/GCRP) as areas requiring special emphasis in order to respond to critical national and international needs. Expected results of significant increases in funding are described for each of these five areas:

International Data-Collection Campaigns.

Major advances are expected in international data-collection efforts, including the World Ocean Circulation Experiment (WOCE), the Joint Global Ocean Flux Study (JGOFS), the Tropical Ocean-Global Atmosphere (TOGA) program, Global Ocean Ecosystems Dynamics (GLOBEC) Program, the Global Tropospheric Chemistry Program (GTCP), and the Water and Energy: Atmospheric, Vegetative and Earth Interactions (WEAVE) Program. Examples of these advances are:

- Completion of the one-time hydrographic survey of the Indian Ocean.
- Refinement of global calculations of meridional heat flux carried by the oceans.
- Determination of the effects of the ocean on monsoon variability.
- Completion of analyses of carbon fluxes in the equatorial Pacific.
- Full implementation of the international Arabian Sea seasonal carbon-flux field program.
- Implementation of the international atmospheric Aerosol Characterization Experiment (ACE) to assess the role of aerosols in the earth's radiation balance.
- Initiation of field campaigns to investigate interactions and feedbacks among water vapor, clouds, and radiation.
- Completion of the development of instrumentation to obtain continuous measurement of the solar features and processes affecting variability of the sun's irradiance.

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- Analysis and interpretation of ice-core records from Greenland and other regions to provide additional information on the natural variations in past atmospheric chemistry, aerosol levels, and climates.

Climate Modeling and Forecasting.

Increased support for climate modeling and forecasting activities places heavy emphasis on expansion of the Climate Modeling and Prediction Program. Foremost among the expected accomplishments of these programs, which are being expanded in coordination with related efforts by other US/GCRP agencies, are:

- Development of the first high-resolution Earth system models that describe interactions among the atmosphere, biota, ice, land-surface, and oceans, including representations of ocean dynamics and biogeochemistry, atmospheric dynamics and chemistry, terrestrial ecology and biogeochemistry, and sea-ice-climate interactions.
- Establishment of a national climate-modeling computing laboratory that will enable multiple 100-year calculations that will provide continental scale climate predictions and sensitivity analyses for evaluating the reliability of the predictions.
- Development of inferential methods needed for multi-dimensional, high-resolution analysis of climate systems through active collaboration between mathematical and natural scientists.

Terrestrial Ecology.

Working in conjunction with other US/GCRP agencies, NSF will expand the Ecological Rates of Change (EROC) and Water and Energy: Atmospheric, Vegetative and Earth Interactions (WEAVE) programs and establish a new Ecological Diversity Program. Expected accomplishments of these programs are:

- Better understanding of the effects of global change phenomena on the biological and ecological diversity of natural and managed ecosystems
- Establishment of a knowledge base on how changes in biological diversity, from genes through ecosystem levels, affect the structure and function of biological life support systems.
- Determination of how ecological diversity alters or can ameliorate the deleterious effects of global change.
- Identification of the processes through which global change, especially climate change, affects processes within biological systems.
- More complete understanding of the effects of biota on climate, the atmosphere and geosphere.
- Improved knowledge about the role of energy and water in climate processes through clarification of processes within, and interactions among atmospheric, surface hydrologic, and biotic systems that affect and are affected by global energy and climate cycles.

Policy Sciences.

An expanded Human Dimensions of Global Change Program will place special emphasis on research on processes related to the development, implementation, and evaluation of policies and other formal responses to global change. Expected accomplishments resulting from this expansion are:

- Sponsorship of research that links the specific knowledge-based needs of the global change community with the advancement of basic research in the area of policy sciences.
- Development of new or advanced models of policy processes in order to encourage the integration of theories, methodologies, and approaches from various substantive disciplines.
- Creation of forums for the exchange of information and ideas between basic researchers in the area of policy sciences and decision makers in the policy analysis community.
- Development of basic tools necessary for the explanation and description of policy-related activities in the area of global change, including methodological advances and refinements and the collection of unique databases.

Methods for Integrated Assessment.

A new Methods for Integrated Assessments Program is being established jointly by all directorates and offices that support focused global change research in order to develop approaches for dealing with complex decision and policy problems. Key features of integrated assessment problems include: explicit and important influences of multiple physical and human systems, highly interdependent consequences, and fundamental needs for interdisciplinary perspectives. Expected outcomes of the development of this program are:

- New or enhanced collaborations that link advanced methods in statistical analysis, forecasting, modeling, and computation to integrated assessment frameworks. Examples include research that links climate models with advanced methods in economic modeling and forecasting.
- Improvements in the modeling and characterization of significant facets of integrated assessments, including the valuation of environmental goods, the modeling of ecosystem functions, or the development of techniques for statistical inference and prediction in large, complex models.
- Advances in approaches for organizing, creating access to, and handling data for integrated assessment problems.
- Increased collaboration among statisticians, natural scientists, and social scientists to improve computational efficiency and greater accuracy in the interpretation of data from observations and models of Earth system processes.
- Improved techniques and models are tested through integrated assessments of the impacts of global change in the Arctic, an especially sensitive region where anticipated changes will be great and where changes have global consequences. These integrations will use paleoclimate data for testing and validation of model simulations.

QUESTION: Do any of these activities support or provide funds to meet the mandates of the U.S. Climate Action Plan which was agreed to last Fall?

ANSWER: The U.S. Climate Action Plan, which was released in October 1993, outlines actions the U.S. expects to take to limit the emissions of greenhouse gases in the year 2000 to the emission levels of 1990. It also commits the U.S. to examine long-term strategies to reduce the emissions of greenhouse gases.

Increased funding for the U.S. Global Change Research Program (US/GCRP) is intended to sustain and expand efforts to meet the needs of decision makers implementing the plan. Expanded programs at NSF are designed to improve the basis for decision making by adding to the understanding of critical processes that result in global change, including interactions between oceans, the atmosphere, and terrestrial systems, as well as knowledge about the effects of global changes on ecosystems. Decision makers also will benefit from improved climate modeling and forecasting capabilities, methods for integrated assessments, and analyses of the processes through which policies are formulated, implemented and evaluated.

QUESTION: **What percentage of the Math and Physical Sciences activity budget is devoted to the strategic initiatives? How does this number compare with the amount NSF requested of OMB for fiscal year 1995?**

ANSWER: Approximately $300 million or 45 percent of the Mathematical and Physical Sciences Activity budget is devoted to the strategic initiatives. This is roughly the same percentage as proposed to OMB and was mutually acceptable.

QUESTION: **Please provide for the record, the exact dollar amounts requested by NSF for the various strategic areas.**

ANSWER: The following table displays the requested funding for strategic areas within the Mathematical and Physical Sciences (MPS) Activity:

FY 1995 BUDGET REQUEST FOR
MATHEMATICAL & PHYSICAL SCIENCES
(dollars in millions)

	FY 1995 Request
RESEARCH IN STRATEGIC AREAS	
Advanced Manufacturing Technology	$49
Advanced Materials and Processing Program	$203
Biotechnology	$19
Civil Infrastructure Systems	$13
Environmental Research including Global Change	
US Global Change Research Program	$6
Environmental Research	$19
High Performance Computing and Communications	$25
Science, Math, Engineering and Technology Education	$35

No other distribution of support for strategic areas within MPS was discussed with OMB.

BUDGET QUESTIONS

1. Let's turn to the Human Space Flight account. The 1995 budget request for this account is $5.7 billion, a decrease of $350 million below the comparable 1994 amount.

Let's look at a couple more issues regarding the Russian participation in the space station program. As I understand it, on March 21, NASA received the Russian Space Agency's contract proposal for joint station activities. But the Russian bid was $650 million, not the $400 million that the U.S. said it would pay during 1994 - 97.

- Is it correct that the Russians now want $650 million and not $400 million?
- If so, explain this situation to the Subcommittee.
- Why should we pay more to the Russians -- and from where would you propose obtaining the funds?

2. Questions have been raised about the conditions of the physical infrastructure of the Russian launch site (Cosmodrome) and the fact that this site is in another country, Kazakahstan.

- Do you believe that the launch site infrastructure is deteriorating and will require an investment of financial resources?

- You would not propose that the U.S. pay for such a "investment" -- would you?

3. Concern has been expressed that U.S. jobs will be lost because of the downsizing of the space station, and the Russian merger. Concern has also been expressed about Russian hardware being in the "critical path".

- What do we say to those concerned about U.S. job loss due to the downsizing of the station and the fact that certain pieces of Russian hardware are essential in the development of the space station?

4. There is a concern with another of our foreign partners -- Canada. Because of financial problems, Canada plans to reduce its space station costs.

- Explain this problem -- and will it require the United States to provide additional funds for the space station program to make up for the Canadian reduction?

- If so, how much additional funding will be required?

5. As I understand it, it will take 34 flights to assemble the space station.

- Is that correct?

- How many launches of Russian and U.S. vehicles will be necessary to complete the space station? I'm talking about the additional flights for crew visits, experiments, propellants and other items necessary for logistical purposes.

6. The space station will require a number of hours of space walks to complete the assemblage. Because there is a risk involved in these space walks, the fewer hours spent in assemblage the better.

- How many hours of space walk do you estimate it will take to assemble the space station?

- How does that compare to the number of hours estimated to assemble space station Freedom?

- What is NASA doing to reduce the number of hours of space walks?

7. The orbit plan for the international space station restricts shuttle launches to a five minute period every 24 hours. As I understand it, a review of past countdowns showed NASA launched within five minutes of the scheduled lift off time only 31 percent of the time.

- Is that correct?

- What does NASA intend to do to try to improve its chances for launch on a given day?

- Does NASA anticipate relaxing any of the safety restrictions for space station flights? If so, explain.

8. As with any Federal contract program, there are always termination costs.

- What do you estimate will be the close out costs of the Freedom program contracts?

- When do you estimate that those contracts will be closed out?

9. There have been stories that our astronauts in Star City are having trouble getting basic necessities for living.

- Is this true?

- How do living conditions for our astronauts in Star City compare with the living conditions for Russian cosmonauts in Houston?

- Is NASA doing anything to improve the living conditions for our astronauts in Russia?

order of $550 million. The lightweight fuel tank appears in the current shuttle budget and will increase the lift capability of the shuttle.

- Will there be other modification costs to allow shuttle to fly the 51 degree orbit for station launches?

- If so, what would those modifications cost -- and are they assumed in your outyear cost projections?

11. The Reston program office has been closed and a space station program office of approximately 300 civil servants is being established in Houston. That office was scheduled to be staffed in December of 1993.

- What is the current employment of the space station program office in Houston?

- When do you estimate the office will be fully staffed?

- Why has it taken longer than scheduled to fully staff the office?

12. Concern has been heard that there may be a problem for research because of the noisy vibrational environment due to the Russian elements.

- Is this a problem for station?
- If so, how big of a problem and how much will it cost to develop a method of isolating the payload racks?
- Is the funding requirement for this in the current station budget? If not, explain.

13. One of the concerns for the space station from the beginning has been the amount of power available for users. The Russians provide the initial power -- 13 kw.

- Is that correct?
- The power available to users for research decreases as housekeeping power requirements increase due to additional parts being added to the station. Power available to the users eventually decreases to approximately 3-4 kw -- isn't that correct?
- How long after the power drops to below 6 kw to the user is it before the U.S. power arrays come on line?

- Until the U.S. power arrays come on line, there won't really be much power available to the users for research - - will there?

14. In a letter to Dr. Gibbons dated April 5, Louis Lanzerotti said of his review of the redesigned space station in late March that research for space station and shuttle need to be vigorously prioritized. He believes that there is a need for strong peer review of any research to be undertaken.

- Does NASA agree that there needs to be strong peer review and prioritization of station research?

- If so, what steps is NASA taken to ensure that Mr. Lanzerotti concerns are addressed?

15. The Subcommittee is concerned with cost threats to the station program -- unresolved costs and liens on reserves.

- Are there any current cost threats to the station program? If so, what, and how do you plan to resolve them?

16. NASA has a number of projects in early development stages -- which NASA calls Phase A or Phase B development. A number of these projects are in the space science area.

- How many projects are currently in Phase A and how many in Phase B?

- What dollar amount is assumed in the 1995 budget request for Phase A studies? For Phase B studies?

- Provide for the record a table listing projects in Phase A studies and Phase B studies and the number of years they have been in the study phase.

17. You are requesting $131 million for space station operations, a new activity in 1995. These costs will increase significantly in future years.

- What was the basis for determining that this level of funding was needed for space station operations in 1995?

- What would happen if a reduction of say $20 million was taken in this area?

18. The agency is requesting $3.3 billion for the space shuttle program in 1995, a decrease of approximately $200 million below 1994. The justifications indicate that this will support a maximum flight rate of eight launches.

- What do you estimate would be the savings in 1995 if the flight rate was reduced by two?

- What would the savings be in the outyears if the number of shuttle flights per year were reduced to a maximum of six?

- How high of a priority does NASA place on a shuttle launch rate of eight per year? With the Subcommittee's 602 allocation, it does seem likely that NASA funding will have to be reduced below the requested level -- the question is where.

19. On page HSF 3-4, the justification indicates that the space shuttle program aggressively continues its plans to significantly reduce the cost of operations.

- How much more can shuttle operations costs be reduced before there is a safety problem? Operations costs have gone from approximately $2.9 billion in 1993, to $2.6 billion in 1994, to $2.4 billion in 1995.

20. The Aerospace Safety Advisory Panel's annual report noted more than 1,200 positions have been eliminated by the shuttle processing contractor since 1991 at the Kennedy Space Center.

reduced further?

– Does NASA plan to further reduce this area – after 1995? The Safety Panel concluded that "additional reductions of the magnitude already taken cannot likely be made without a higher probability of impacting safety."

21. To improve shuttle safety, the Committee recently approved a reprogramming of $13.6 million to restart the alternate turbo pump program.

– How confident is NASA that it can control the development and implementation costs of the ATP? The overall program – both the oxygen and hydrogen pumps – is one that has experienced serious cost growth above the initial estimate.

22. Turn to Space Science. You are requesting $1.77 billion in 1995 for space science, an increase of $44 million above the comparable 1994 level. In his opening statement, the Administrator said regarding space science, "new starts in the outyear budgets could amount to $100 to $300 million per year . . . " . To address this matter, the Administrator has challenged the Office of Space Science to come up with $100 million in savings. If you do it, he will match it with another $200 million.

– Is that a fair characterization of the situation?

Congressman Louis Stokes

QUESTION: Turning to the Social, Behavioral, and Economic Sciences. For fiscal year 1995, the Agency is requesting $112,610,000 or an increase of 14.6 percent. Within this activity I note that the Social, Behavioral, and Economic Research Subactivity is projected to increase by almost 19 percent. What types of activities do you expect to fund in this area?

ANSWER: Of the total requested increase of support for the Division of Social, Behavioral, and Economic Research (SBER), $13.0 million is to increase support for Global Change research activities. Increases are proposed for two lines of inquiry: Policy Sciences, an expanded Human Dimensions of Global Change Program with a special emphasis on research on processes related to the development, implementation, and evaluation of policies; and Methods for Integrated Assessments, a new cross-directorate program to develop approaches for dealing with decision and policy problems for which studies of impacts and consequences require broader ranges of information than do standard research activities.

The other area for which we have requested an increase in FY 1995 is High Performance Computing and Communications. SBER is requesting $1.88 million to augment HPCC activities, primarily in the area of modeling human cognition processes in language, memory, and problem-solving.

Ongoing activities in SBER are being maintained. These include: research on the process of Democratization, investigations into factors effecting worker productivity and skill utilization - Human Capital, and research on Intelligent Systems.

QUESTION: There has traditionally been tension between the university professor and the industry researchers. Also, research centers tend to be subject-oriented, bringing together computer scientists and psychologists to work on cognitive science, or biologists and engineers for biotechnology work. With sufficient industrial participation, these research centers may reward industrial, as well as academic, experience.

-- Should this process be encouraged?

ANSWER: The Engineering Research Centers, the Science and Technology Centers, the Supercomputing Centers, and the Industry/University Cooperative Research Centers have all, to varying degrees, established successful programs of collaboration with industry, where industry provides advice to establish research needs, participates in collaborative research, and mentors students. As a result of these types of collaborations and agreements, new products have been generated, new research tools and processes invented, new small companies created, and a new type of more sophisticated student has emerged. We have found this a mutually enriching process, bringing longer term thinking to industry and perspectives on technology and industrial problems to academe, and plan on continuing to encourage more of these collaborations.

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Some areas in which we would like to see further encouragement are:

1. Opportunities for student collaboration on industry-defined projects, often with the work performed on-site in industry.
2. University/industry cooperation in experimental testbeds to create prototypes for industry-led, university-energized discovery.
3. Opportunities for collaborative research among university and industry investigators. This strategy is particularly effective when there are one-to-one working relationships and people exchanges; e.g. when university-trained researchers and professionals move to industry and vice-versa.

QUESTION: **How does one know if the process has gone too far in one direction or another?**

ANSWER: It is very important for NSF to keep a balanced portfolio. The total portfolio of NSF's support to universities, colleges and collaborations with the private sector remains under frequent review by the National Science Board to ensure that fundamental research of all types is given a chance to flourish in this research environment.

QUESTION: Currently, there are various Antarctic bills pending in the House of Representatives. Has the Administration proposed its own legislation or has it taken a position with regard to these various bills?

ANSWER: The Administration has proposed its own bill. This was submitted by Representative Rick Boucher in the House as H.R. 3532 and by Senator Pell in the Senate as S. 1831.

An interagency group led by the Department of State, with representatives from the Environmental Protection Agency, National Oceanographic and Aeronautical Administration, Department of Defense, Department of Justice, Department of Interior, Department of Transportation, the Coast Guard, the National Science Foundation and the Council on Environmental Quality worked over a period of several months to develop implementing legislation for the Environmental Protocol to the Antarctic Treaty. The Administration bill would implement the Protocol by replacing the Antarctic Conservation Act with legislation that enacts measures to implement the provisions of the Protocol and its five annexes. It would also create a new prohibition on mineral resource activities in Antarctica consistent with the Protocol.

QUESTION: **According to page 194 of the justification, the 10-year lease of the Polar Duke research vessel expires at the end of 1994. Could you tell us about your plans once this lease expires?**

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ANSWER: In February 1994 NSF's Antarctic support contractor, Antarctic Support Associates (ASA) issued an RFP for a replacement vessel. The lease for the POLAR DUKE will be extended as necessary to provide a reasonable time for provision of the replacement vessel.

The RFP requires that the vessel be U.S. flagged and must be built or modified in a U.S. yard. In addition, price is a major evaluation factor -- the vessel sought should be in the price range of POLAR DUKE.

QUESTION: As I am sure you are aware, in the FY 1994 Appropriations bill, the committee included language prohibiting the expenditure of funds on an arctic research vessel unless it was built in a U.S. shipyard. What is the Foundation's understanding of this provision? Are you proceeding in accordance with that provision?

ANSWER: The FY 1994 Appropriations bill provides that none of the funds made available for Research and Related Activities may be used to acquire through lease, purchase or other means an arctic research vessel. The conference report for the bill defers further action on the arctic research vessel pending receipt of a report from the General Accounting Office (GAO) on the costs and benefits associated with the various acquisition strategies (including lease, purchase, debt financing, and other mechanisms) which could be pursued by the NSF or its institutional operator.

Consistent with direction provided by Congress, action on acquisition of an arctic research vessel has been deferred pending outcome of the GAO analysis of acquisition options. The planning effort will continue with refinements in the preliminary design and maintenance of the scientific planning process. Funds for the ship will be subject to a new budget request for FY 1996 or later years, consistent with overall Foundation priorities for new major research equipment and facilities. NSF will ensure all Congressional guidance and Federal competitive requirements are met in all phases of the procurement process. The award for initial design and testing was made to the University of Alaska, which subcontracted with Glosten Associates, a U.S.-owned organization based in Seattle, Washington. NSF will require that the arctic research vessel be a U.S.-flagged vessel.

QUESTION: The recently enacted supplemental bill included some recissions for the Foundation. I understand that the Foundation will take some of this reduction out of procurement activities related to Polar Programs. Please update the budget justification for this activity to reflect this change in your FY 1994 program.

ANSWER: Funding for Polar Programs is not affected by the supplemental bill. However, the FY 1994 Current Plan for Polar Programs is $5 million below the FY 1994 Budget Request, due to Congressionally-mandated reductions in the Department of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriation Act of 1994, signed in October 1993. Part of this reduction ($4 million) affects Polar facilities improvements and operations, as reported in the FY 1995 budget justification.

Congressman Louis Stokes

The supplemental bill passed in February 1994 requires a $10 million reduction from the FY 1994 Current Plan -- $5 million in Academic Research Instrumentation and Facilities, and $5 million in Research and Related Activities. The table below includes the revised NSF accounts for FY 1994:

(Millions of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Change	
				Amount	Percent
Research and Related Activities/1	2,046.31	2,163.70	2,348.70	185.00	8.6%
Education and Human Resources	505.06	569.60	586.00	16.40	2.9%
Academic Research Infrastructure	49.75	105.00	55.00	-50.00	-47.6%
Major Research Equipment	34.07	52.00	70.00	18.00	34.6%
Salaries and Expenses	110.84	118.30	130.72	12.42	10.5%
NSF Headquarters Relocation	0.00	5.20	5.20	0.00	0.0%
Office of Inspector General	3.69	4.00	4.38	0.38	9.5%
TOTAL, NSF	$2,749.73	$3,017.80	$3,200.00	$182.20	6.0%

1/ Within Research and Related Activities, the $5 million reduction is taken from Engineering ($3 million), Mathematical and Physical Sciences ($1 million) and Biological Sciences ($1 million).

However, the FY 1995 Budget includes a government-wide savings allowance for reinventing Federal procurement which assigns to the NSF a reduction of $463,000 in procurement funds agency wide. Of this reduction, slightly more than $400,000 is allocated to the Research and Related Activities appropriation, within which the majority of procurement funds are for Polar Programs activities. Of the balance, $26,000 is allocated to the Education and Human Resources appropriation and $34,000 to the Salaries and Expenses appropriation.

Congressman Louis Stokes

QUESTION: The Committee is aware that the LIGO project has had some management issues that the Foundation asked Caltech to address. The Foundation notified the Committee that certain changes were made including naming a new principal investigator and project director.

To what extent will these changes affect staffing requirements, the project's schedule and, in the end, the total cost of the LIGO project?

ANSWER: Caltech has named Barry Barish (Professor of Physics at Caltech) as Principal Investigator of LIGO with overall responsibilities for the project. On March 5, 1994, he notified NSF of a planned reorganization of the project management and other actions which should satisfy NSF requirements for improved management of the project. It is likely that this will require a modest increase in the staff. Reaching agreement on the resolution of the management issues may have caused a short delay in the project's schedule. Both of these may affect the total cost. An external cost review is currently underway. As soon as NSF staff has received the report of this review and determined the extent of the impact these changes will have, we will inform the Committee.

QUESTION: If the figures and narrative in the 1995 justification are not the latest numbers, please provide updated estimates for construction funding and key project milestones sufficient to take the project through completion. (If changes were made, please explain.)

ANSWER: The current estimate of the construction cost for LIGO is $231 million, up from the original estimate of $211 million, because of stretching out the time to completion from that originally planned. These costs are currently being reviewed by NSF with the assistance of an outside team of experts. Preliminary activities took place in early April. The current plan calls for the cost review to be completed by October 1, 1994. We will inform the Committee as additional information becomes available. The key milestones for completion remain the same, although the timing may be affected by the short delay due to resolving management issues.

QUESTION: Also, please update the estimated annual operating costs for this project based upon the current construction schedule. (If changes were made, please explain.)

ANSWER: At this time, the estimated annual operating costs for LIGO are $12 million . The external review team which is currently reviewing the LIGO project is examining this issue.

QUESTION: I understand there may be some issues surrounding the site access and development of the two LIGO sites. Please provide a status report on development issues for both the Washington State and Louisiana sites.

ANSWER: Everything at the Hanford, WA site is moving along on schedule. We have a permit to use the site and a Finding of No Significant Impact (FONSI) on the environment. Geotechnical studies have been completed and rough grading of the site is in progress. At the Livingston, LA site, we appear to be close to completing negotiations on site access and environmental approval, but the final steps still remain to be taken. We are expecting that existing draft documents will soon be formally submitted to NSF recommending a FONSI.

Congressman Louis Stokes

Although negotiations for obtaining access to the site have not yet been completed, it appears that the process can still be completed without introducing significant schedule delays.

QUESTION: I understand that the agreements for the international cost sharing of the GEMINI telescopes are now in place. if the figures and narrative in the 1995 justification are not the latest numbers, please provide updated estimates for construction funding and key project milestones sufficient to take the project through completion. (If changes were made, please explain.

ANSWER: The figures and narrative in the 1995 justification are the latest numbers. The attached table provides a complete funding plan for all partners.

ESTIMATED CONTRIBUTIONS
(Dollars in Millions)

	NSF 50%	Canada 15%	U.K. 25%	Chile 5%	Argentina 2.5%	Brazil 2.5%	Total 100%
1991	$4.00						$4.00
1992	$12.00						$12.00
1993	$14.00	$6.81	$3.64		$0.40		$24.85
1994	$17.00		$4.40		$0.57	$0.55	$22.52
1995	$20.00	$3.10	$5.20	$2.93	$0.57	$0.55	$32.35
1996	$21.00	$5.00	$5.50	$2.94	$0.57	$0.55	$35.56
1997		$5.10	$5.60	$2.93	$0.57	$0.55	$14.75
1998		$5.10	$5.70		$0.57	$0.55	$11.92
1999		$1.29	$5.70		$0.57	$0.55	$8.11
2000			$4.80		$0.57	$0.55	$5.92
2001			$3.46			$0.55	$4.01
2002							
2003							
Total	$88.00	$26.40	$44.00	$8.80	$4.40	$4.40	$176.00

QUESTION: Also, please update the estimated annual operating costs for this project based upon the current construction schedule. (If changes were made, please explain.)

ANSWER: The recently updated preliminary estimate of the operating costs for the Gemini telescopes is $10.6 million per year, of which the U.S. would provide 50 percent. This is based on an operational model in which the operations in Hawaii are combined with those of the Joint Astronomy Center (which operates the United Kingdom Infrared Telescope and the James Clark Maxwell Telescope, both on Mauna Kea) and the operations in Chile are combined with those of the Cerro Tololo Inter-American Observatory. Sharing of manpower, physical plant, and other resources will result in considerable savings over a stand-alone operation. The project will be reviewing these models (particularly the requirements for continuing facility and instrumentation upgrades) as the telescopes approach operational status.

Congressman Louis Stokes

QUESTION: For the past few years, the Foundation has built up its infrastructure efforts with both the academic research facilities modernization program and an academic research instrumentation program. The latest set of proposals for the instrumentation program was due by March 15, 1994 and the facilities proposals are due on April 5, 1994.

What is the volume of proposals received by the Foundation? What is the total dollar request contained in the proposals for both of these solicitations?

ANSWER: In response to the solicitation for research instrumentation, 420 proposals have been received requesting approximately $174 million. In response to the solicitation for research facilities, 281 proposals have been received requesting approximately $226 million.

QUESTION: Generally, what is the success rate for proposals submitted to these programs?

ANSWER: The success rate for the last competition for academic research instrumentation was about 26%. The success rate for the 1993 competition for academic research facilities was approximately 30%.

QUESTION: On average, what percentage of the proposals submitted are of sufficient quality to warrant support?

ANSWER: In the academic research facilities modernization competition, the merit review panels recommended that NSF support approximately 46% of the proposals that competed in FY 1993. The panels that reviewed the academic research instrumentation proposals, during the FY 1992 competition, recommended approximately 52% of the proposals for support by the NSF.

QUESTION: Given the requested budget for FY 1995, how many proposals does the Foundation expect to be able to support?

ANSWER: Given the requested budget for academic research infrastructure, the Foundation expects to make about 50 awards for academic research facilities and about 23 awards for academic research instrumentation in FY 1995.

Congressman Louis Stokes

QUESTION: **For the record, please provide some information about the Biological Sciences Minority Postdoctoral Fellowships.**

ANSWER: The following information on the Biological Sciences Minority Postdoctoral Research Fellowships is provided for the record.

- Program initiated in FY 1990.
- Supports postdoctoral study by recent Ph.D.'s who are members of ethnic groups underrepresented in science in the US.
- Award duration is up to three years, funding may include: $28,000 stipend, $4,600 research costs, $2,400 institutional allowance per year.
- Funding may also include a 2:1 match, up to $35,000, for one year starter grant after faculty appointment.
- Eligible graduate students can get up to $3,000 travel support to visit labs to arrange for postdoctoral study.
- First class of Fellows have completed their fellowships. Of the fellows we have information on: 3 have secured employment as assistant professor; 1 has entered the Civil Service; 1 is actively interviewing for an academic position; and 3 are continuing their postdoctoral training.

Annual History of Program

	Applicants	Awards	Dollars
FY90	33	10	$1,050,000
FY91	48	12	$1,260,000
FY92	21	10	$1,050,000
FY93	34	11	$1,155,000
FY94	40	(est)10	$1,050,000
FY95	(est)45	(est)10	$1,050,000

Gender and Ethnic Group History, FY90 - FY93
(Dollars in Thousands)

	Applicants			Awards						
				Male		Female		Total		
Group	Male	Female	Total	#	Dollars	#	Dollars	#	Dollars	% Succ
Native American	2	0	2	1	$105	0	$0	1	$105	50%
Black	28	23	51	10	$1,050	6	$630	18	$1,680	31%
Hispanic	43	26	69	15	$1,825	8	$840	23	$2,415	33%
Pacific Islander	2	5	7	1	$105	2	$210	3	$315	43%
TOTAL	75	54	129	27	$2,885	16	$1,680	43	$4,515	33%
% success				36%		30%		33%		

Congressman Louis Stokes

QUESTION: The Department of Defense has provided logistical support necessary for this Nation to maintain an active and influential presence in the Antarctic and this Committee has supported the need for DOD to provide this support. Currently, discussions are on-going with DOD regarding a reduced role for DOD for this program. Please provide the core services that must be provided by DOD to maintain the active and influential presence called for in Presidential Memorandum 6646? What is the status of these discussions?

ANSWER: As of the middle of April these points are still being discussed with DOD officials and members of the Executive Office of the President.

Questions Submitted for the Record
by
Congressman Esteban E. Torres

QUESTION: Can you please provide for the record the location (state, county and city) of the following programs: Minority Summer Science Camps, Partnerships for Minority Student Achievement, Comprehensive Regional Centers for Minorities, Research Careers for Minority Scholars, Research Improvement in Minority Institutions, Minority Research Centers of Excellence, and Minority Institutions for Excellence?

ANSWER: The following tables provide the information on the Minority Summer Science Camps, Partnerships for Minority Student Achievement, Comprehensive Regional Centers for Minorities, Research Careers for Minority Scholars, Research Improvement in Minority Institutions, Minority Research Centers of Excellence, and Minority Institutions for Excellence.

Summer Science Camps (SSC) Program
Total Number Active SSCs 56

Institution/Organization	City	County	State
Anchorage School District	Anchorage	Anchorage	AK
University of Alaska (Fairbanks)	Bethel	Bethel	AK
Alabama A&M University	Normal	Madison	AL
California State University	San Marcos	San Diego	CA
California State University	Sacramento	Sacramento	CA
California State University (Domiguez Hills)	Carson	Los Angeles	CA
East Bay Consortium of Education	Oakland	Alameda	CA
Harvey Mudd College	Claremont	Los Angeles	CA
San Diego State University	San Diego	San Diego	CA
San Francisco State University	San Francisco	San Francisco	CA
University of California	Berkeley	Alamedo	CA
Connecticut Pre-Engineering Program, Inc.	West Hartford	Hartford	CT
University of the District of Columbia	Washington		DC
Clark Atlanta University	Atlanta	Fulton	GA
Kennesaw State College	Marietta	Cobb	GA
Loyola University	Chicago	Cook	IL
Purdue University	West Lafayette	Tippecane	IN
Purdue University (Calumet)	Hammond	Lake	IN
Jefferson County Public Schools	Louisville,	Jefferson County	KY
French River Education Center, Inc.	Dorchester	Cumberland	ME
National Aquarium	Baltimore		MD
Black Child and Family Institute	East Lansing	Ingram	MI
Detroit Area Pre-Col. Eng. Program	Detroit	Wayne	MI
Jackson State University	Jackson	Hinds	MI
University of Minnesota	Duluth	Saint Louis	MN
Bennett College	Greensboro	Guilford	NC

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University of North Carolina	Wilmington	New Hanover	NC
Cook College	New Brunswick	Middlesex	NJ
New Jersey Institute of Technology	Newark	Essex	NJ
UMDNJ-New Jersey Medical School	Newark	Essex	NJ
New Mexico Museum of Nature Hist & Sci.	Albuquerque	Bernalillo	NM
Bank Street College	New York	New York	NY
Eugenio Maria De Hostos Community Col.	Bronx	Bronx	NY
John Jay College	New York	New York	NY
Rensselaer Polytechnic Institute	Troy	Rensselaer	NY
Rochester Institute of Technology	Rochester	Monroe	NY
Science Skills Center	Brooklyn	Kings	NY
SUNY College (Fredonia)	Fredonia	Chautaugua	NY
SUNY College (Old Westbury)	Old Westbury	Nassua	NY
SUNY College (Stoney Brook	Stony Brook	Suffolk	NY
Prep Tech - University of Toledo	Toledo	Lucas	OH
Oklahoma State University	Stillwater	Payne	OK
Delaware Valley College	Doylestown	Bucks	PA
University of Rhode Island	Kingston	Washington	RI
University of South Carolina	Columbia	Richland	SC
South Dakota School of Mines and Tech.	Rapid City	Pennington	SD
Oak Ridge Associated Universities	Oak Ridge	Knox	TN
Southwest Texas State University	San Marcos	Hays	TX
Texas A&M University	College Station	Brazos	TX
The Science Place	Dallas	Dallas	TX
University of Texas	Austin	Travis	TX
Hampton University	Hampton		VA
Seattle University	Seattle	King	WA
University of Washington	Seattle	King	WA
Marquette University	Milwaukee	Milwaukee	WI

Partnerships for Minority Student Achievement (PMSA) Program
Total Number Active PMSAs 9

Institution/Organization	**City**	**County**	**State**
Santa Unified School District	Santa Ana	Orange	CA
Los Angeles Unified School District (Reg. C)	Los Angeles	Los Angeles	CA
New Haven Public Schools	New Haven	New Haven	CT
Prince Georges County Public Schools	Upper Marlboro	Prince Georges	MD
Normandy School District	St. Louis	St. Louis	MO
Durham Public Schools	Durham	Durham	NC
Rochester City School District	Rochester	Monroe	NY
Chattanooga Public Schools	Chattanooga	Hamilton	TN
Brownsville Independent School District	Brownsville	Cameron	TX

Congressman Estaban E. Torres

Comprehensive Regional Centers for Minorities (CRCM) Program
Total Number Active CRCMs 14

Institution/Organization	City	County	State
Maricopa Community College	Phoenix	Maricopa	AZ
California State University	Los Angeles	Los Angeles	CA
Florida A&M University	Tallahassee	Leon	FL
Loyola University	Chicago	Cook	IL
Northeastern University	Boston	Suffolk	MA
Morgan State University	Baltimore		MD
University of Missouri	Rolla	Phelps	MO
Jackson State University	Jackson	Hinds	MS
Montana State University	Bozeman	Gallatin	MT
New Mexico Highlands University	Las Vegas	San Mequel	NM
Minorities in Math., Sci., and Eng. (M2SE)	Cincinnati	Hamilton	OH
PATHS/PRISM	Philadelphia	Philadelphia	PA
University of Texas	San Antonio	Bexar	TX
University of Texas (UTEP)	El Paso	El Paso	TX

Research Careers for Minority Scholars (RCMS) Program
Total Number Active RCMSs 50

Institution/Organization	City	County	State
Talladega College	Talladega	Talladega	AL
Tuskegee University	Tuskegee	Macon	AL
Northern Arizona University	Flagstaff	Coconino	AZ
University of California	Riverside	Riverside	CA
California State University	Hayward	Alameda	CA
University of California	La Jolla	San Diego	CA
Harvey Mudd College	Claremont	Los Angeles	CA
San Diego State University	San Diego	San Diego	CA
University of California	Irvine	Orange	CA
Fort Lewis College	Durango	La Plata	CO
Howard University	Washington		DC
Florida A&M University	Tallahassee	Leon	FL
Clark Atlanta University	Atlanta	Fulton	GA
Morehouse College	Atlanta	Fulton	GA
Spelman College	Atlanta	Fulton	GA
Spelman College	Atlanta	Fulton	GA
University of Guam	Mangilao		GUAM
Southern Illinois University	Edwardsville	Madison	IL
Chicago State University	Chicago	Cook	IL
Iowa State University	Ames	Story	IO
Grambling State University	Grambling	Lincoln	LA
Southern University	Baton Rouge	East Baton Rouge	LA

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Xavier University	New Orleans	Orleans	LA
MIT	Cambridge	Middlesex	MA
University of Maryland	Baltimore		MD
University of Maryland Eastern Shore	Princess Anne	Somerset	MD
Wayne State University	Detroit	Wayne	MI
University of Michigan	Ann Arbor	Washtenaw	MI
Jackson State University	Jackson	Hinds	MS
Bennett College	Greensboro	Guilford	NC
Princeton University	Princeton	Mercer	NJ
Navajo Community College	Shiprock	Socorro	NM
CUNY City College (2)	New York	New York	NY
SUNY (Old Westbury)	Old Westbury	Old Westbury	NY
Fordam University	New York	Bronx	NY
State University of New York (SUNY)	Stony Brook	Suffolk	NY
Polytechnic University	Brooklyn	Kings	NY
University of Oklahoma	Norman	Cleveland	OK
Oklahoma State University	Stillwater	Payne	OK
Pennsylvania State University	University Park	Centre	PA
University of Puerto Rico	San Juan		PR
South Carolina State University	Orangeburg	Orangeburg	SC
University of Texas (UTEP)	El Paso	El Paso	TX
Texas A&M University	College Station	Brazos	TX
University of Texas	San Antonio	Bexar	TX
University of Texas	Austin	Travis	TX
Hampton University	Hampton		VA
Marquette University	Milwaukee	Milwaukee	WI

Research Improvement in Minority Institutions (RIMI) Program
Total Number Active RIMIs 61

Institution/Organization	**City**	**County**	**State**
Alabama A&M University	Normal	Madison	AL
Tuskegee University (3)	Tuskegee	Macon	AL
Northern Arizona University	Flagstaff	Coconino	AZ
California State University (2)	Los Angeles	Los Angeles	CA
California State University	Carson	Los Angeles	CA
Howard University	Washington		DC
University of the District of Columbia (2)	Washington		DC
Florida A&M University (2)	Tallahassee	Leon	FL
Clark Atlanta University (5)	Atlanta	Fulton	GA
Morris Brown College	Atlanta	Fulton	GA
Chicago State University	Chicago	Cook	IL
Kentucky State University	Frankfort	Franklin	KY
Southern University (3)	Baton Rouge	East Baton Rouge	LA

Congressman Estaban E. Torres

Morgan State University	Baltimore		MD
Wayne State University (2)	Detroit	Wayne	MI
Jackson State University (2)	Jackson	Hinds	MI
North Carolina A&T State University (2)	Greensboro	Guilford	NC
New Mexico State University (3)	Las Cruces	Dona Ana	NM
New Mexico Highlands University	Las Vegas	San Miguel	NM
University of New Mexico	Albuquerque	Bernalillo	NM
City College (CUNY)	New York	New York	NY
University of Puerto Rico (3)	Rio Piedras		PR
University of Puerto Rico (2)	San Juan		PR
University of Puerto Rico	Mayaguez		PR
Tennessee State University	Nashville	Davidson	TN
Meharry Medical College (5)	Nashville	Davidson	TN
St. Mary"s University	San Antonio	Bexar	TX
University of Texas (3)	El Paso	El Paso	TX
Prairie View A&M University	Prairie View	Waller	TX
University of Texas	San Antonio	Bexar	TX
Texas A&I University	Kingsville	Kleberg	TX
Hampton University (5)	Hampton		VA

Minority Research Centers of Excellence (MRCE) Program
Total Number Active MRCEs 8

Institution/Organization	**City**	**County**	**State**
Alabama A&M University	Normal	Madison	AL
Howard University	Washington		DC
Clark Atlanta University	Atlanta	Fulton	GA
City College (CUNY)	New York	New York	NY
University of Puerto Rico	Mayaquez		PR
Meharry Medical College	Nashville	Davidson	TN
University of Texas	El Paso	El Paso	TX
Hampton University	Hampton		VA

Minority Institutions for Excellence (MIE) Program
Total Number Active MIEs (Planning grants) 15

Institution/Organization	**City**	**County**	**State**
Spelman College	Atlanta	Fulton	GA
Southern University	Baton Rouge	East Baton Rouge	LA
Xavier University	New Orleans	Orleans	LA
Jackson State University	Jackson	Hinds	MS
City College (CUNY)	New York	New Yorks	NY
Central State University	Wiberforce	Greene	OH

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Oklahoma State University	Stillwater	Payne	OK
Lincoln University	Lincoln University	Chester	PA
Universidad Metropolitana	Rio Piedras		PR
University of Puerto Rico	Cayey		PR
Oglala Lakota College	Kyle	Shannon	SD
University of Texas	El Paso	El Paso	TX
St. Mary's University	San Antonio	Bexar	TX
Texas A&M University at Kingsville	Kingsville	Kleberg	TX
Hampton University	Hampton		VA

Questions Submitted for the Record
by
Congressman Jerry Lewis

Critical Technologies Institute--FFRDC

QUESTION: The Foundation participates in the Operating Committee which tasks the Critical Technologies Institute (CTI). CTI is Federally Funded Research and Development Center (FFRDC). In defense, which is my other appropriations subcommittee, we fund 11 FFRDC's and they have a combined annual budget of $1.3 billion.

We have spent more time than the subject justifies in that subcommittee addressing the unique status of FFRDC's. The controversial issues include revolving doors between agency programs and foundation board of directors, salaries for FFRDC employees that greatly exceed what can be paid in the civil service, and the indirect expenses of such FFRDC's.

Today we are talking about a $2 million FFRDC. That's not to say we won't be discussing a much larger entity in five years.

Which federal agency in the operating committee actually oversees the contract with RAND for CTI?

ANSWER: The National Science Foundation administers the contract with RAND.

QUESTION: How many employees will receive salaries and expenses from this year's allocation for CTI?

ANSWER: The estimated number of employees is 66 (20.4 FTEs) for both FY 94 and FY 95.

QUESTION: What are top 2 or 3 research priorities which will be undertaken by CTI in FY 95?

ANSWER: CTI's research agenda is developed by the Office of Science and Technology Policy, consistent with certain statutory requirements. The aim is to develop a balanced agenda that reflects OSTP's near and long term needs. Some projects that CTI will be working on in FY 95 include:

- Federal R&D Expenditure Database
- Support of the National Science and Technology Council
- Environmental Technology Strategy
- Strategies for Promoting the Use of Technology in Education and Training

Congressman Jerry Lewis

Earthquake Research Centers

QUESTION: In 1988 the Foundation completed a national competition which resulted in the establishment of a single earthquake research center in Buffalo, New York. I'm remembering this because California lost out in that competition.

This year the Foundation will actually be supporting two completely separate earthquake research centers. The Buffalo Center is within the Civil & Mechanical Systems Subactivity and has an explicit focus upon basic research into the structural components of buildings and bridges.

You will also be supporting the Southern California Earthquake Center which is affiliated with USC. My understanding is that their work is not so much about structures as it is about models for earthquake prediction.

Aside from the budgetary reality that the centers are funded in different engineering subactivities, are they really performing distinct earthquake research missions?

ANSWER: The two centers perform different, but complementary, functions.

The Southern California Earthquake Center (SCEC) is a NSF Science and Technology Center which is funded through the Geosciences Directorate. The research at SCEC is aimed at quantifying earthquake hazards through a master model. This model uses data from the Southern California area, and integrates data and theory into a geographic database that can be used by scientists, engineers, and government officials to reduce earthquake hazards. The research at SCEC is closely integrated with state and local engineering and emergency preparedness officials. One of SCEC's accomplishments has been the identification of previously unknown fault zones within the Los Angeles metropolitan area.

The National Center for Earthquake Engineering Research (NCEER) is funded through the Engineering Directorate and is focused on the hazards earthquakes pose to the built environment, including buildings, lifelines and bridges. The engineering research that is conducted at NCEER is integrated with efforts in the earth and social sciences to maximize its relevance to mitigation and preparedness efforts throughout the country. NCEER also has a proactive information dissemination program, which enables it to make research results available in a timely fashion to practitioners and code officials. One of NCEER's accomplishments is that it has facilitated the adoption of seismic provisions in codes in the East as well as in other parts of the nation.

QUESTION: They would appear to be funded at different levels with approximately twice as much going to Buffalo.

Does that simply reflect the fact that Buffalo is an established center while the Southern California Center is just now coming together?

ANSWER: NCEER has received $4 million in support from NSF in both FY 93 and 94, while SCEC received $1.8 million and $2.8 million, respectively, for those fiscal years. This difference in funding is not related to the length of time that the centers have been in operation. The funding level for each center reflects the unique research and training activities undertaken at the centers.

QUESTION: Is it correct that your FY 95 budget provides approximately $2 million to the Southern California Earthquake Center? How many researchers and students are involved at this location?

ANSWER: The FY 95 budget request includes approximately $3 million for the Southern California Earthquake Center. Additional support from the U.S. Geological Survey of approximately $1.2 million is anticipated. The number of researchers and student participants are approximately: Faculty Participants - 49, Non-Faculty Participants - 29, Visiting Researchers - 11, Post Graduate Researchers - 16, Graduate Students - 45, Undergraduate Students - 10.

Northridge Supplemental

QUESTION: Public Law 103-211, the supplemental appropriations bill for the Northridge earthquake and U.S. peacekeeping expenses, which Congress passed last month, provided $15 million for studies associated with that natural disaster.

There were some issues during our deliberations about how that $15 million would be distributed among the federal agencies that contribute to the National Earthquake Hazard Reduction program.

Does the Foundation yet understand what its share of that $15 million will be?

ANSWER: The NSF share of the Northridge Supplemental will be $7 million, with $2.4 million going to the Geosciences Directorate, and $4.6 million going to the Engineering Directorate.

QUESTION: It occurred to me at the time that the $15 million for research should not have been labeled as an emergency requirement. And yet, we were told that there was an urgency inasmuch as some of the data on aftershocks and other matters could only be gathered in the immediate aftermath of the earthquake.

Has the money been released to you by FEMA yet?

ANSWER: FEMA is in the process of transferring to NSF the Foundation's share of the supplemental funding. Transfer of funds documents have already been exchanged between the two agencies.

QUESTION: Where will the Foundation's portion of the money go and what do you hope to accomplish with it?

ANSWER: Part of the funds will be used to supplement the Southern California Earthquake Center's major role in the collection of perishable information on the Northridge earthquake and the archival of that data in a form readily accessible to others.

Congressman Jerry Lewis

The major NSF portion of the funds will be used to support research at academic institutions on the Northridge earthquake through a special announcement issued by the National Earthquake Hazards Reduction Program (NEHRP) agencies. The research will cover such areas as the hazard environment, the built environment, and socioeconomic impacts. In contrast to the initial efforts of the NEHRP agencies to collect perishable information on the event, this research will involve more systematic data collection and analysis. The aim is to learn as much as possible from the Northridge earthquake that can be used to further earthquake hazard reduction throughout the country.

LIGO

QUESTION: This marks the 4th consecutive year of funding for construction of the two American gravitational wave detectors. You are ramping up to $50 million in FY 95 for LIGO.

Is it correct that construction funding for the two LIGO sites in Washington and Louisiana will terminate with the FY 97 request and that no more than $55 million will be requested in each of the last two years of the program?

ANSWER: The final year of construction funding is scheduled to be FY 98. Following the reduction from $43 million to $35 million in FY 94, the completion schedule was delayed to FY 98. This delay, together with an anticipated small increase in the number of personnel, to strengthen the controls on cost, schedule and scope, will lead to a modest increase in the cost. We expect the required construction funding in FY 96 and FY 97 to be $55 million and about $15 million in FY 98. These costs are currently being reviewed by NSF with the assistance of an outside team of experts. Preliminary activities took place in early April. The current plan calls for the cost review to be completed by October 1, 1994. The report will enable us to verify or correct our estimates. We will inform the Committee as additional information becomes available.

QUESTION: I understand that you expect a groundbreaking ceremony at the Washington State site later this year. Your justification mentions that land acquisition negotiations are still in progress for the Louisiana component.

What is the nature of the site in Livingston Parish? Is it a former federal facility, state land, or some combination of private and government land?

ANSWER: The land is in two parcels, both privately held. The larger parcel is owned by a paper company that uses it as a tree farm. Funds have been appropriated by the Louisiana State Legislature for Louisiana State University to purchase the land. The land will be leased for a nominal sum to the federal government for use by LIGO.

QUESTION: Does the process of locating a federally supported facility require a full blown environmental impact statement in this instance?

ANSWER: Construction of LIGO will require either a Finding of no Significant Impact (FONSI) or a full Environmental Impact Statement. An environmental study at the

Hanford site led to a Finding of No Significant Impact by LIGO at Hanford. An environmental study is being completed for the Louisiana site. A draft report of this study, soon be submitted to the NSF, recommends a FONSI. If the NSF agrees with the conclusions of the report and finds no significant impact on the environment, a full blown Environmental Impact Statement will not be required.

National Performance Review

QUESTION: Under the Vice President's NPR legislation, it is anticipated that federal agencies would reduce staff through various means by approximately 12% over five years. I can't help but note that NSF has a modest increase scheduled over last year.

Did you receive some type of OMB blessing or exemption regarding the Foundation's contributions under NPR?

ANSWER: Although NSF has received no exemptions from NPR recommendations, NSF's request for FTE in FY 1995 does exceed the FTE level for FY 1994. The reductions required for NPR were calculated from the FY 1993 base which, for NSF was 1343. However the FY 1994 appropriation for Salaries and Expenses was not sufficient to fund the allowable FTE level. In addition, the Foundation is actively participating in the National Performance Review's recommendations in many other ways. For example, under the Government Performance and Results Act, OMB has designated NSF as a pilot agency in five activities related to performance planning and performance reporting.

QUESTION: The chart on page 234 of the justification details how the proposed increase of 40 FTE would be allocated. I can't help but note that none of the additional employees will go to budget finance and awards management. And yet, your justification notes that the Foundation's workload has more than doubled is judged by the number of proposals received.

The argument, I guess, is that the same number of people are processing an increasing amount of work over time. And yet these increases seem to be allocated into individual disciplinary directorates. Can you help me understand how these positions were allocated?

ANSWER: Although administrative offices would also benefit from FTE increases, the research and education directorates, where the time-consuming processes of program development, proposal solicitation and evaluation, and program review occur, have been most significantly affected by growth in funding levels. Therefore, they have been allocated additional FTEs. To arrive at our allocation of FTE between the research and education directorates, we examined workload across the Foundation over the most recent five-year period and identified the directorates where additional programmatic activity over this period has had the greatest impact on workload and associated staffing requirements. The allocation in the FY 1995 justification reflects both the staffing requirements created over this five-year period and the new requirements due to program budget levels for FY 1994 and 1995.

Congressman Jerry Lewis

Advanced Technological Education--Community Colleges

QUESTION: The Foundation proposes to spend $17.6 million in FY 95 for the Advanced Technological Education program which was authorized by Public Law 102-476--the Scientific and Advanced Technology Act.

It's my understanding that the authorization level for this program is actually $35 million. Is that correct?

ANSWER: The Advanced Technological Education program was authorized at $35 million for fiscal year 1992; and $35 million for fiscal year 1993.

QUESTION: FY 94 would actually be the first year in which the Foundation had the funds to make awards to community colleges under this program. Is that correct?

ANSWER: Yes, FY 94 was the first year in which the Foundation had the funds to make awards to community colleges under the Advanced Technological Education program; however, the Foundation did make awards to community colleges prior to FY 1994.

QUESTION: Where are you currently in terms of proposals received? How many awards do you expect to make and how many proposals did you actually receive?

ANSWER: On November 1, 1993, 317 preliminary proposals were received. All have received assistance and advice. In addition, on November 1, 1993, we received 33 formal proposals for planning grants for Centers. Of these 33 proposals, six awards were made. As a consequence of the preliminary proposal process, 116 formal proposals for projects, 17 proposals for implementation awards for Centers, and 33 proposals for planning grants for Centers have been received to date. Decisions on awards will be made in FY 1994. We expect to fund approximately 40 projects and up to five Centers in FY 1994.

QUESTION: The authorization bill allows the creation of up to 10 centers for technical education? Will you be creating any centers with either the FY 94 awards or the funding we provide for your FY 95 request?

ANSWER: We expect to fund up to five Centers in FY 1994 and, depending upon funding availability, up to three in FY 1995.

National Science Foundation

Justification of Estimates of Appropriations to the Congress

Fiscal Year 1995

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NATIONAL SCIENCE FOUNDATION $3,200,000,000

The FY 1995 Budget Request for the National Science Foundation is $3,200.00 million, an increase of $182.20 million, or 6.0 percent, over the FY 1994 Current Plan of $3,017.80 million. This level includes $2,474 million for research activities and $586 million for education and human resources.

This investment will support more than 19,500 projects in research and education, directly involving almost 150,000 students, teachers, scientists, mathematicians, and engineers. These activities will produce the new knowledge necessary to address a range of national priorities and to advance our understanding of all types of scientific phenomena and technological processes. These activities also contribute directly to strengthening the scientific and technical workforce and raising the scientific literacy of all Americans.

NSF's Role in the Nation's Science and Technology Strategy

The Administration has assigned high priority to investments in science and technology that will help to secure the nation's future economic growth and social progress. In the February 1993 report -- *Technology for America's Economic Growth, A New Direction to Build Economic Strength* -- President Clinton and Vice President Gore announced a science and technology policy that is built around three central goals:

- Long term economic growth that creates jobs and protects the environment,
- A government that is more productive and more responsive to the needs of its citizens, and
- World leadership in basic science, mathematics and engineering.

The National Science Foundation's many unique strengths and experience in the basic sciences and engineering enable it to play a fundamental and central role in fulfilling all three of the Administration's science and technology policy goals. Specifically, NSF is committed to:

- Ensuring world class standards of excellence in research through a system of merit review.
- Dedicating its resources to discovery, understanding, training, and education.
- Supporting a wide range of activities that facilitate innovation in both research and education.
- Maintaining the flexibility to identify and pursue new opportunities.
- Leading the development of partnerships between industry, universities, and government.
- Stimulating advances in information technologies and electronic networks that make both government and other sectors of the economy more efficient, productive, and responsive.

Furthermore, NSF's FY 1995 Budget Request emphasizes research and education activities that address major underlying issues and challenges facing our society -- competing in world markets, mitigating threats to the environment, improving efficiency in all sectors, educating our citizens, and improving quality of life for all Americans.

NSF – An Investment in the Nation's Future

The National Science Foundation is the only federal agency mandated to maintain the health and vitality of the U.S. academic science and engineering enterprise. To fulfill this responsibility, the Foundation's programs provide support for research in all fields of the natural, physical, and social sciences; mathematics; engineering; and science, mathematics, and engineering education at all grade and achievement levels.

Because so many of the challenges facing the nation require sustained progress in research and education, NSF's programs represent a vital investment in the nation's future – and all of NSF's budget for research and education activities has been classified as investment in the President's fiscal year 1995 budget.

The Foundation's broad base of activities is essential to sustaining America's tradition of excellence in science, mathematics, and engineering. The most recent round of Nobel Prize awards testifies to these high standards, as U.S. researchers, many supported by NSF, accomplished a near "clean sweep" in scientific areas. Today, NSF is dedicated to ensuring that this tradition of excellence contributes to the fullest extent possible to improving the quality of life and increasing opportunities for all Americans.

Furthermore, to ensure that the nation's investment in NSF produces a high return, the Foundation is placing greater emphasis on evaluating its programs and tracking progress in key areas. A number of programs and individual projects have developed milestones that provide clear indicators of the viability of particular investments and their prospects for success. The information provided by these measures will help the agency identify priorities for future budgetary and planning decisions.

A summary of the request by appropriation follows.

(Millions of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Change Amount	Change Percent
Research and Related Activities /1	2,046.31	2,168.70	2,348.70	180.00	8.3%
Education and Human Resources	505.06	569.60	586.00	16.40	2.9%
Academic Research Infrastructure /2	49.75	100.00	55.00	-45.00	-45.0%
Major Research Equipment /3	34.07	52.00	70.00	18.00	34.6%
Salaries and Expenses	110.84	118.30	130.72	12.42	10.5%
NSF Headquarters Relocation	0.00	5.20	5.20	0.00	0.0%
Office of Inspector General	3.69	4.00	4.38	0.38	9.5%
TOTAL, NSF	$2,749.73	$3,017.80	$3,200.00	$182.20	6.0%

1/ Displays proposed merger of Research and Related Activities, U.S. Polar Research Programs, U.S. Antarctic Logistical Support, and Critical Technologies Institute appropriations into a redefined Research and Related Activities appropriation.

2/ FY 1994 Current Plan for Academic Research Infrastructure excludes $10 million proposed for rescission.

3/ Major Research Equipment (MRE) appropriation is proposed in FY 1995 to fund the construction of major research equipment currently funded through the Research and Related Activities appropriation. For comparability, the FY 1993 and FY 1994 amounts for these construction projects are shown in MRE.

Research and Education in Strategic Areas

The FY 1995 NSF Budget Request provides strong support to a number of interagency and NSF initiatives that are directly relevant to national priorities. This budget provides substantial increases to focused sets of research and education activities in areas including high performance computing and communications; global change research; science, mathematics, engineering and technology education; advanced manufacturing technology; advanced materials and processing; biotechnology; civil infrastructure systems; and environmental research.

(Millions of Dollars)

	FY 1994 Estimate	FY 1995 Estimate	Percent Change
Advanced Manufacturing Technology	191.10	196.27	2.7%
Advanced Materials and Processing Program	311.08	313.18	0.7%
Biotechnology	199.49	205.69	3.1%
Civil Infrastructure Systems	51.10	54.10	5.9%
Environmental Research including Global Change			
U.S. Global Change Research Program	141.90	207.52	46.2%
Environmental Research	144.44	156.04	8.0%
High Performance Computing and Communications	266.99	328.62	23.1%
Science, Math, Engineering and Technology Education	625.14	650.19	4.0%

Note. Projects which have strong connections to the goals and objectives of more than one initiative are difficult to attribute to single initiative. In an effort to present a more precise measure of its research and education initiatives, NSF will redefine its internal data collection and analysis capabilities so that the allocation of resources for these initiatives can be shown in a mutually exclusive manner.

Highlights from these activities include:

- **Global Change Research:** NSF's support for the U.S. Global Change Research Program totals $207.52 million, an increase of 46.2 percent or more than $65 million, over FY 1994. NSF's efforts focus on improving knowledge of the fundamental physical, biological, and socioeconomic processes related to global change. Special attention will be given in FY 1995 to major international data-collection and analytical programs; to climate change modeling and forecasting activities; to research on terrestrial ecology; to research on climate change policy processes; and to advancement of methods for conducting integrated assessments related to global change.

  Complementary activities supported through NSF's **Environmental Research** initiative total more than $156 million in FY 1995, including research in environmental technologies and environmental biology.

- **High Performance Computing and Communications (HPCC):** NSF's FY 1995 budget includes $328.62 million for HPCC, an increase of 23.1 percent or almost $62 million, over FY 1994. Ongoing activities support research in areas ranging from research focused on parallel computing, to Grand Challenge and National Challenge applications that have direct impacts on areas such as the design of new drugs and health care, to research on the development of digital libraries to efforts for remote observation and experimentation. This Request includes more than $50 million for the **Information Infrastructure Technology and Applications** component of HPCC which seeks to develop the common services, systems and environments necessary to fulfill the Administration's vision for the National Information Infrastructure .

- **Advanced Manufacturing Technology:** Research and education activities in Advanced Manufacturing Technology total $196.27 million in FY 1995. Ongoing programs support fundamental research in areas including environmentally-benign manufacturing techniques; advanced fabrication and processing methods; development of intelligent manufacturing systems; and the Agile Manufacturing Initiative, a coordinated effort of NSF and ARPA. The FY 1995 increase builds on a large FY 1994 increase and focuses on research involving agile manufacturing, the programmable factory, and rapid prototyping.

- **Science, Mathematics, Engineering, and Technology Education:** As discussed below, all parts of the Foundation contribute to strengthening the capabilities of the nation's scientific and technical workforce. Funding for NSF's portion of this interagency initiative will total $650.19 million in FY 1995, over half of which is specifically aimed at K-12 education.

In all of these focused efforts, including the Global Learning and Observations to Benefit the Environment initiative, the research and education activities supported by NSF are designed in keeping with both the agency's mandate of maintaining the health of science and the Administration's goal of maintaining U.S. world leadership in science and engineering. The full range of the science and engineering disciplines supported by NSF participate in these initiatives. Therefore, these activities fulfill the agency's fundamental mission of promoting the progress of science and engineering, and at the same time focus on the strategic needs of the nation.

Education and Training

Virtually every dollar spent by NSF is in some way an investment in education and training. Research grants provide support for senior scientists, mathematicians and engineers, postdoctoral researchers, technicians, graduate students, and in certain instances, undergraduates and secondary school students. Education programs reach teachers and students at all grade and achievement levels and in all regions of the country, with the goal of engaging all students in science -- not only those who will be the engineers, scientists, technicians and teachers of the future, but all who will need this knowledge to function and prosper in our increasingly technology-based society.

One of NSF's foremost contributions to the nation's science and engineering capabilities is in helping to maintain and strengthen the scientific and technical workforce. An example of NSF's commitment in this area is the Foundation's Advanced Technological Education program, which promotes improvement in technological education through support for curriculum development, primarily through two-year colleges. Other innovative programs integrate industry concerns into academic coursework and provide students and researchers with valuable opportunities to interact with industry, augmenting and enhancing academic research experiences.

In FY 1995, support for education and training will total approximately $777 million across NSF, including more than $650 million for the Science, Mathematics, Engineering, and Technology Education initiative. Highlights of the Foundation's activities include:

- **Systemic Reform in K-12 Education:** NSF will continue to provide national leadership to spur reform of K-12 education in science, mathematics, engineering, and technology, with total funding of more than $360 million. Of particular note are NSF's systemic reform initiatives, targeting states, major cities, and rural areas -- linking school systems with different levels of government, academic institutions, local businesses, and science museums and other organizations.

- **Reform of Undergraduate Education:** In undergraduate education, NSF provides support for course and curriculum development; laboratory instrumentation; research experiences; and other programs focused on technical, two- and four-year colleges, and universities. Funding totals almost

$190 million, including nearly $12 million provided for an initiative to improve technological workforce capabilities.

- **Graduate and Postdoctoral Education:** Included in the more than $94 million for graduate and postdoctoral education and training programs are NSF Graduate Fellowships and Minority Graduate Fellowships, and Graduate Research Traineeships.
- **Evaluation and Assessment:** Since evaluation activities are essential for improving ongoing NSF education and training programs, as well as for identifying successful projects for widespread dissemination, NSF's funding for these areas will total more than $10 million in FY 1995, an increase of 14.5 percent.

Number of People Involved in NSF Activities

Under the FY 1995 budget, the Foundation's programs will directly involve almost 150,000 people, almost twice as many people as five years ago. These range from senior researchers working at major universities to secondary school students participating in science summer camps.

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Senior Researchers	23,000	24,800	25,800
Other Professionals	7,900	8,400	8,700
Post-Doctorates	4,300	4,500	4,900
Graduate Students	19,600	20,700	21,300
Undergraduate Students	11,400	13,700	14,100
K-12 Teachers	46,200	55,200	59,500
K-12 Students	11,100	12,900	12,900
Total Number of People	123,500	140,200	147,200

In addition, an estimated 10 million people are indirectly impacted by NSF programs. These programs reach K-12 students, K-12 teachers, and researchers through activities including workshops; informal science activities such as museums, television, and videos; outreach efforts; and dissemination of improved curriculum and teaching methods. Further, research funded by NSF has had a broad impact, ultimately affecting the lives of all Americans.

Improving Efficiency and Productivity

Under this budget, NSF will continue to pursue strategies to improve its internal operations and its ability to serve the research and education community. As was noted in the report of the National Performance Review (NPR), NSF has helped pioneer advances in such areas as electronic networking and the application of advanced technologies to administrative functions. In fact, the NPR report called upon NSF to continue pushing forward in these areas and to develop a systematic means for sharing its achievements with other Federal agencies.

NSF's FY 1995 Budget Request includes funding for a number of specific efforts to further automate the agency's operations and improve the efficiency of its programs.

- To move toward paperless processing of research grants, NSF will invest $3.0 million on research to expand its capabilities to receive, review, and process proposals electronically and to disseminate publications and other information electronically. This will result in reducing the administrative burden on universities and enable grantees to receive information more efficiently.

- In FY 1995, NSF will also continue to develop new assessment and evaluation techniques as part of pilot projects under the Government Performance and Results Act.

More generally, the Foundation is placing greater emphasis on developing milestones and specific evaluation criteria for programs throughout the agency. For example, the budget justifications for major construction projects now contain specific milestones that identify critical points in the progress of each project.

A Vision of the Future of NSF

The Administration, through its investment strategy, has outlined a vision for the crucial role of science and technology in securing a brighter future for all Americans. This vision includes a growing economy that provides an increased number of high-wage, high-skill jobs; a cleaner environment; an educational system that provides a foundation for continually improving skills and training; and a vibrant and vital research community that continues to set world-class standards for excellence in science, mathematics, and engineering.

As a key player in the Federal science and technology effort, the National Science Foundation will work in partnerships with other agencies, states, and industry to transform this vision into reality. The programs and activities supported through this budget will advance the frontiers of new knowledge and bring such knowledge to bear on national priorities, spur productivity improvements in all sectors, lead reforms at all levels of education, and help to develop a workforce for the 21st Century with scientific and technical skills of the highest order.

In sum, because so many aspects of the nation's future rest upon our capabilities in science, mathematics, and engineering, the research and education activities supported by the National Science Foundation represent vital and necessary investments that will provide the highest possible return to all Americans.

ACTIVITY SUMMARIES

Funding for the National Science Foundation is provided in the following seven appropriations.

Research and Related Activities

The FY 1995 Request for Research and Related Activities (R&RA) is $2,348.70 million, an increase of $180.0 million, or 8.3 percent, over the FY 1994 level [1]. R&RA funds a broad range of activities focused on strengthening the nation's scientific, mathematics, and engineering research enterprise. Included is support for research projects, centers, instrumentation, user facilities necessary for forefront research, and education and training activities. Also included within R&RA is support for research in the arctic and antarctic regions, and the necessary logistics and operations support to enable such research.

Within R&RA, funding for research and education in strategic areas increases by approximately 12 percent over the FY 1994 planned level. Efforts in these strategic areas produce the knowledge necessary to address a range of national priorities, to advance our understanding of scientific phenomena and technological processes, and to strengthen the science and technical workforce. Significant increments include:

- **U.S. Global Change Research Program** increases by more than $65 million, or 46.2 percent, for a total of $207.52 million. Special attention will be given in FY 1995 to major international data collection and analytic programs; to climate change modeling and forecasting activities; to research on terrestrial ecology; to research on policy processes; and to the advancement of methods for conducting integrated assessments.

- **High Performance Computing and Communications** initiative increases by more than $61 million, or 24.5 percent. This includes more than $50 million for **Information Infrastructure Technology and Applications** for information infrastructure services, system development, intelligent interfaces, and National Challenge Applications Problems in areas which have broad impact on the nation's competitiveness.

- Support for the interagency **Science, Mathematics, Engineering and Technology Education** initiative increases by more than $9 million, or 8.4 percent, to $118.53 million. R&RA-funded education programs are directed primarily at post-secondary education. Increased support in FY 1995 focuses primarily on improving undergraduate education.

Significant support is also provided within R&RA for efforts in strategic areas including **Advanced Manufacturing Technology**, **Environmental Research**, **Advanced Materials and Processing**, **Civil Infrastructure Systems**, and **Biotechnology**.

Funding for fundamental research in disciplinary and cross-disciplinary research in all fields of science and engineering supported by NSF will continue. Within R&RA, research project support increases by 10.3 percent to $1,406 million; funding for centers increases by 4.4 percent for a total of $184 million; support for facilities increases by 6.0 percent to a total of $559 million; and funding for education and training activities increases by 5.2 percent to a total of $199 million.

1/ The Major Research Equipment (MRE) appropriation is proposed in FY 1995 to fund the construction of the Laser Interferometer Gravitational Wave Observatory (LIGO) and the Gemini 8-meter telescopes, currently funded through R&RA. For comparability, the FY 1993 and FY 1994 amounts for these construction projects are shown under MRE.

Education and Human Resources

The FY 1995 Request for Education and Human Resources (EHR) is $586.00 million, an increase of $16.40 million, or 2.9 percent, over the FY 1994 Current Plan. EHR supports a cohesive and comprehensive set of activities, augmented by informal science experiences, which encompass every level of education and every region of the country. EHR plays a major role in science, mathematics, engineering and technology education, funding about thirty percent of the total federal effort in FY 1995.

- Support at the **K-12** level totals $360.05 million, an increase of $8.87 million over FY 1994. Included in this amount are **Systemic Reform** activities ($86.06 million) in states, urban and rural areas, and programs to meet the National Education Goals in science and mathematics, established in 1990 by the President and the nation's governors.

- Support at the **Undergraduate** level is $102.25 million, an increase of $2.44 million over FY 1994. This support focuses on the continued efforts of reforming curriculum and laboratory instruction, and upgrading equipment. Improving undergraduate preparation of K-12 teachers and addressing advanced technician training continues to be major emphases.

- Support at the **Graduate** level is $63.39 million, an increase of $4.60 million over FY 1994. Included in this support is a modest increase in both the stipend and the cost of education allowance for the Graduate Fellowship program. The number of fellows will be sustained at approximately 2,400. The Graduate Traineeship program will be sustained at the FY 1994 level.

- **Advanced Technology Education** (ATE) established in FY 1994, is $17.60 million, an increase of $3.00 million over the FY 1994 level. ATE promotes improvement in advanced technological education curricula and instruction to help in the transition of students to the high-performance workforce. The increase will support new centers and expansion of curriculum projects.

Academic Research Infrastructure

The FY 1995 Request for Academic Research Infrastructure is $55.0 million, a decrease of $45.0 million from the FY 1994 Current Plan level of $100.0 million, but the same level requested in FY 1994. Because academic infrastructure needs are so pervasive, only with the concerted cooperative effort of every agency that funds academic research, and with the support of the Congress, can the federal government begin to address the large scale modernization and instrumentation requirements of our science laboratories and classrooms. The $55.0 million Request is the amount NSF feels is sufficient to allow the continued upgrading and improvement of research facilities and instrumentation at academic institutions, while maintaining the Foundation's traditional role in the research community.

Major Research Equipment

The FY 1995 Request for the new Major Research Equipment (MRE) appropriation is $70.0 million. MRE is established in FY 1995 to provide funding for the construction of major research facilities that provide unique capabilities at the cutting edge of science and engineering. Currently funded through the Research and Related Activities (R&RA) appropriation, these construction projects totaled $34.07 million in FY 1993 and $52.00 million in the FY 1994 Current Plan. The FY 1995 Request of $70.00 million represents an $18.00 million increase, or 34.6 percent, over the FY 1994 level for these items.

Projects supported by this Account will push the boundaries of technological design and will offer significant expansion of opportunities, frequently in totally new directions, for the science and engineering community.

Two projects currently comprise the Major Research Equipment Account: the Laser Interferometer Gravitational Wave Observatory (LIGO) and the Gemini Telescopes, twin 8-meter telescopes in the northern and southern hemispheres being built through an international partnership.

Salaries and Expenses

The FY 1995 Request for Salaries and Expenses (S&E) is $130.72 million, an increase of $12.42 million, or 10.5 percent, over the FY 1994 Current Plan level of $118.30 million. The Request level fully funds the Foundation's staffing requirement of 1,243 full-time equivalents and will enable NSF to exercise effective management of its programs and activities and to continue its investment in advanced information technology.

Salaries and Expenses provides funds for staff salaries and benefits, and general operating expenses necessary to manage and administer the NSF. Funds are requested separately for the Office of Inspector General and for NSF Headquarters Relocation, the appropriation account which includes funds to reimburse the General Services Administration (GSA) for expenses incurred to relocate the Foundation to its new Headquarters location in Arlington, Virginia.

NSF Headquarters Relocation

The FY 1995 Request for NSF Headquarters Relocation is $5.20 million, equal to the FY 1994 level. This appropriation account provides annual reimbursement to the General Services Administration (GSA) through FY 1998 for expenses incurred by GSA pursuant to the relocation of the National Science Headquarters to Arlington, Virginia, which was completed in January 1994.

Office of Inspector General

The Office of Inspector General (OIG) was established to promote economy, efficiency, and effectiveness in administering the Foundation's programs; to detect and prevent fraud, waste, or abuse within NSF or by individuals that request or receive NSF funding; and to identify and resolve cases of misconduct in science. The FY 1995 Request for the OIG is $4.38 million, an increase of $0.38 million over the FY 1994 level.

RESEARCH AND EDUCATION IN STRATEGIC AREAS

NSF provides support for a number of research and education initiatives in strategic areas. These initiatives increase the potential for early application of newly discovered knowledge by promoting and facilitating cooperation between universities, industries, and government. Examples of initiatives emphasized in this budget are:

(Millions of Dollars)

	FY 1994 Estimate	FY 1995 Estimate	Percent Change
Advanced Manufacturing Technology	191.10	196.27	2.7%
Advanced Materials and Processing Program	311.08	313.18	0.7%
Biotechnology	199.49	205.69	3.1%
Civil Infrastructure Systems	51.10	54.10	5.9%
Environmental Research including Global Change			
U.S. Global Change Research Program	141.90	207.52	46.2%
Environmental Research	144.44	156.04	8.0%
High Performance Computing and Communications	266.99	328.62	23.1%
Science, Math, Engineering and Technology Education	625.14	650.19	4.0%

Note: Projects which have strong connections to the goals and objectives of more than one initiative are difficult to attribute to single initiative. In an effort to present a more precise measure of its research and education initiatives, NSF will redefine its internal data collection and analysis capabilities so that the allocation of resources for these initiatives can be shown in a mutually exclusive manner.

Advanced Manufacturing Technologies (AMT) totals $196.27 million, an increase of $5.17 million or 2.7% over FY 1994. Ongoing activities provide an expanded focus on the integration of design, manufacturing and business management processes and new experimental methods for the rapid prototyping of new products and new manufacturing systems; and develop enabling technologies and computer-based tools needed to support the nation's rapidly changing production system. Special attention will be given in FY95 to research involving agile manufacturing, the programmable factory and virtual and physical rapid prototyping.

Advanced Materials and Processing Program (AMPP) totals $313.18 million, an increase of $2.10 million or 0.7% over FY 1994. The FY 1995 program builds on a large increase in FY 1994 and provides for:

- material synthesis and processing;
- theory, modeling and simulation;
- manufacturing of advanced materials; and
- development and acquisition of advanced instrumentation.

NSF will emphasize:

- the development of crucial new information regarding materials;
- educating and training scientists and engineers to confront the materials-related strategic challenges of the present and future; and
- ensuring the availability of state-of-the-art instrumentation for research and training.

Biotechnology funding totals $205.69 million, an increase of $6.20 million or 3.1% over FY 1994. NSF's efforts focus on environmental and plant biotechnology. Goals include using molecular and other emerging technologies to develop a complete understanding of the basic biology of plants, so that it will be possible to engineer such capabilities as resistance to disease and the ability to grow in poor soils; to discover novel organisms, genes, and biochemical pathways useful for environmental rehabilitation; and to develop biological systems to detect environmental stress.

Civil Infrastructure Systems totals $54.10 million, an increase of 3.00 or 5.9% over FY 1994. The goals of the initiative are to develop new scientific and engineering knowledge leading to new designs, more durable materials, network systems with better controls and communications, and improved decision-making and management processes. Ongoing activities support an integrated cross-directorate, multidisciplinary research effort to develop and apply new scientific and engineering knowledge in the following four key areas: deterioration science, assessment technologies, renewal engineering and institutional effectiveness and productivity. The FY 1995 effort will expand research on:

(1) development of nondestructive evaluation techniques;
(2) innovative remediation methods for infrastructure facilities;
(3) intelligent materials handling and new construction materials and processes;
(4) control devices that counteract weaknesses and/or deformations;
(5) assessment methods and cost-effective retrofit techniques to correct deficiencies to existing structures exposed to earthquake hazards; and
(6) social, behavioral, and economic factors affecting infrastructure management and productivity.

U. S. Global Change Research Program (USGCRP): NSF's support for the U. S. Global Change Research Program totals $207.52 million, an increase of more than $65 million or 46.2% over FY 1994. Research on global change advances fundamental understanding of the Earth's dynamic physical, biological, and socioeconomic systems and the interactions among those systems. In addition to research on Earth system processes and the consequences of changes in those systems, NSF programs facilitate;

- data-acquisition and data-management activities necessary for basic research on global change,
- the enhancement of modeling designed to improve representations of Earth system interactions, and
- the advancement of analytic modes that facilitate the conduct of fundamental research.

NSF also supports fundamental research on the general processes used by governments and other organizations to identify and evaluate different types of policies for mitigation, adaptation, and other responses to changing global environmental conditions. Special attention will be given in FY 1995 to major international data-collection and analytic programs; climate change modeling and forecasting activities; research on terrestrial ecology; research on policy processes; and the advancement of methods for conducting integrated assessments.

Environmental Research: NSF's support for multi-disciplinary research on the environment totals $156.04 million, an increase of $11.60 million or 8.0% over FY 1994. emphasis is on fundamental research across a broad front of sciences (biology, chemistry, engineering, geosciences, materials, mathematics and social sciences) to understand the environment, predict changes in it, and develop strategies for preserving and restoring it -- problems of enormous size and complexity. In FY 1995 special attention will be given to:

(1) *research on the dynamics of critical systems*, including studies of the geochemistry of near-surface environments, the mechanisms by which organisms respond to environmental signals; and the role of biodiversity in maintaining the health of marine and terrestrial environment,

(2) *integrated modeling and analysis,* including modeling of anthropogenic effects on the environment, particularly at regional scales, analysis of geochemical cycling of nutrients and contaminants across land, estuary and ocean interfaces, and development of methods and algorithms for mathematical ecology; and

(3) *research on mitigation and response strategies,* with a special emphasis on enhancing industry-academic interactions in such areas as preventive and remedial environmental technologies, environmentally sound extraction and production systems, and environmental sensors and control systems.

High Performance Computing and Communications (HPCC) totals $328.62 million, an increase of $61.63 million or 23.1% over FY 1994. Included in this amount is an increase of $31.65 million for Information Infrastructure Technology and Applications (IITA). NSF's HPCC programs provides support for basic research in HPCC technologies and applications, national HPCC facilities and services, and education and training. Within HPCC, NSF focuses on:

- heterogeneous and distributed scalable systems to advance computational science;
- on overall coordination of the National Research and Education Network (NREN $^{(sm)}$) program;
- the development of software technologies to address Grand Challenges;
- creating a cadre of scientists and engineers to exploit advanced computational technologies in all disciplines; expediting the application of HPCC technologies to information intensive areas such as digital libraries, the environment, health care education and manufacturing; and
- laying the foundations for the national information infrastructure.

The emphasis in FY 1995 is on the transition to the very high speed backbone network services, research on national challenge application problems; adding additional parallel processors at the NSF Supercomputer centers; expanding metacenter and regional affiliates activities; and increasing Grand Challenge Applications, digital libraries, and software research for scalable parallel computing systems.

Science, Mathematics, Engineering, and Technology Education (SMETE) totals $650.19 million, an increase of $25.05 million or 4.0% over FY 1994. NSF support addresses many of the challenges posed by the National Education Goals established by the President and the nation's governors in 1990 by developing national science education standards at all levels of education. SMETE programs address education and training needs at all levels: K-12, undergraduate, and post-graduate, as well as public science literacy. Efforts focus on promoting curricula and instruction to help students meet the demands of the high-performance workforce of the future. An emphasis in FY 1995 will be on the Advanced Technology Education program. In addition, systemic reform efforts will be a high priority in FY 1995.

MODES OF SUPPORT

NSF funds a broad range of activities focused on strengthening the nation's scientific and engineering research enterprise. Support for research and education activities takes many forms, including awards for individuals and small groups of investigators with their associated equipment, postdoctoral researchers and students; research centers; national user facilities; development and acquisition of instrumentation for individual or shared use; graduate and postdoctoral fellowships; systemic educational reform activities; and workshops and conferences. These activities can be characterized as follows:

(Millions of Dollars)

Modes of Support	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate	% Change FY 94 - 95
Research Projects	1,179.23	1,330.16	1,433.42	7.8%
Facilities	608.27	634.64	656.83	3.5%
Centers	166.96	184.51	192.24	4.2%
Education & Training	680.74	750.99	777.21	3.5%
TOTAL \1	$2,635.20	$2,900.30	$3,059.70	5.5%

1/ Excludes Salaries and Expenses, Office of Inspector General, and NSF Headquarters Relocation

RESEARCH PROJECTS

Research projects provide support for individuals and small groups devoted both to disciplinary research in traditional fields and to cross-disciplinary fields of strategic national importance. Components of research projects may include support for researchers along with postdoctoral associates and undergraduate or graduate assistants. It may also include instrumentation and equipment necessary to carry out research, as well as other related costs such as travel and conference support. In addition, some infrastructure funding may be included for items such as databases, laboratories, and museums.

FACILITIES

The National Science Foundation supports large multi-user facilities which require very long-term commitments for support. These facilities are usually too large, complex, or expensive for individual researchers or small distributed groups to construct on their own. Support for these unique national facilities is essential to advance U.S. research capabilities and to perform world class research. These facilities meet the need for multi-user access to state-of-the-art research facilities that would otherwise be unavailable. Facility support includes funds used to build, maintain, renovate, or operate NSF user facilities.

NSF facilities include: the National Center for Atmospheric Research, the National High Magnetic Field Laboratory, Gemini 8-Meter telescopes, the Laser Interferometer Gravitational Wave Observatory, national astronomy centers, the nanofabrication facility, the oceanographic research fleet, NSFNET, and supercomputing centers. Also included are smaller user facilities in the geosciences, materials research, physics, astronomy, and facilities necessary for polar research. Support is also provided for research and research training facilities modernization.

CENTERS

NSF support for centers is based on the premise that some scientific questions and research problems can best be addressed through the multidisciplinary, long-term, coordinated research efforts of many researchers on the many facets of a complex problem. While individual centers' goals are diverse, all of NSF's centers share common traits including well-defined coordination with industry to ensure that knowledge quickly migrates into the private sector; and a strong educational component to aid the training of this nation's next generation of scientist and engineers and to encourage students of all ages to participate in science.

Types of NSF centers include: Science and Technology Centers; Engineering Research Centers; the Earthquake Research Center; the Center for Ecological Analysis and Synthesis; Long Term Ecological Research Sites; Materials Research Science and Engineering Centers; Minority Research Centers of Excellence; the Critical Technologies Institute; Industry/University Cooperative Research Centers, and State Industry/University Cooperative Research Centers.

EDUCATION & TRAINING

NSF's education and training programs support activities from kindergarten through post-doctoral levels, and also include public science literacy. These efforts aim to enable U.S. students to become scientifically literate citizens, ensure an adequate, well-trained workforce, and maintain U.S. leadership in science and technology. Through these programs, NSF works to achieve National Education Goals which were articulated by the President and the Governors after the 1989 Education Summit.

Precollege programs include rural, urban, and statewide systemic reform initiatives, teacher enhancement programs, and teacher preparation programs. At the undergraduate level, NSF supports course and curriculum development, Engineering Coalitions, and Research Experiences for Undergraduates, in addition to the new Advanced Technological Education Program. Graduate programs include research fellowships, research traineeships, and research training groups, as well as dissertation improvement awards. NSF places special emphasis on groups which have been historically underrepresented in science and engineering fields, namely women, minorities, and persons with disabilities. In addition, NSF funds young investigators, a Public Science Literacy Program, and the Experimental Program to Stimulate Competitive Research.

CENTERS

The National Science Foundation supports a variety of centers programs. While the programs are diverse, they do share several premises:

- Some scientific questions and research problems can best be addressed through the multidisciplinary, long-term, coordinated research efforts of a number of scientists working in unison on the many facets of a complex problem;
- A strong educational component to aid the training of this nation's next generation of scientists and engineers and to encourage the participation in science and engineering of students of all ages and;
- A well-defined coordination with industry to ensure that research is relevant to national needs and that knowledge quickly migrates into the private sector.

NSF supports 163 centers. These centers and center programs are listed below.

(Dollars in Millions)

	Year of Program Initiation	FY 1994 Number of Centers	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate	Percent Change FY 94 - 95
Engineering Research Centers	1985	18	$47.50	$51.50	$51.50	0.0%
Science & Technology Centers	1987	25	51.47	58.08	59.81	3.0%
Industry/University Cooperative Research Centers	1973	55	4.00	4.50	4.50	0.0%
State Industry/University Cooperative Research Centers	1991	10	2.70	3.35	3.35	0.0%
Minority Research Centers of Excellence	1987	8	7.71	7.98	7.98	0.0%
Materials Research Science & Engineering Centers	1972	26	38.58	41.60	42.10	1.2%
Center for Ecological Analysis and Synthesis	1994	1	0.00	1.00	2.00	100.0%
Earthquake Research Center	1988	1	4.00	4.00	4.00	0.0%
Long-Term Ecological Research Sites	1980	18	10.00	11.00	15.00	36.4%
Critical Technologies Institute	1993	1	1.00	1.50	2.00	33.3%
TOTAL		163	$166.96	$184.51	$192.24	4.2%

Engineering Research Centers

The Engineering Research Center (ERC) program was established to address fundamental research issues crucial to the next generation of technological advances from an engineering systems perspective, and to educate a new generation of engineering students using a cross-disciplinary team approach to problem solving. All ERCs focus on research critical to U.S. economic competitiveness, and have a strong education outreach component. They also give priority to the timely transfer of technological advances to industry and other users.

NSF's annual funding of each ERC averages approximately $2.5 million, with a range of $1.3 million to $3.0 million. Total funding from all sources including industry averages about 2.5 times the NSF contribution. In 1993, the 18 centers had over 600 industry partners, about one third of which were small businesses. Over the life of the program, over 450 engineers from industry have worked with engineering students and faculty in the ERCs, and the ERCs have received over 200 patents and have licensed over 500 patents and software products to industry.

Science and Technology Centers

The Science and Technology Centers (STCs) Program supports innovative interdisciplinary research, education, and knowledge transfer efforts in fields of basic science and mathematics. STCs are fostering new approaches that signal a new collaborative culture among university- and industry-based researchers and educators at all levels, from kindergarten to graduate school. The Centers provide opportunities to explore research problems that require interdisciplinary expertise, access to state-of-the-art instrumentation and facilities, and a commitment of high levels of support for sustained periods of time.

STCs have amassed an impressive record of research accomplishments, research training, contributions to K-12 education, and timely transfer of knowledge and technology from the laboratory to industry. Traditional barriers among disciplines and between university, governmental, and industry laboratories have been removed, creating a new mode of leadership and management in research and education. STC research has supported training of hundreds of graduate students and post-doctoral fellows, has pursued research of interest to industrial advisors, has engaged scores of industrial researchers in basic research, and has spawned new companies, products, and jobs. STC research has contributed: new methods of synthesizing industrial diamonds; new market products in the areas of ultra-fast lasers; new designs for deep-space sensors; new insights into earthquake hazards in southern California; progress toward high-temperature superconducting materials; and a variety of other developments serving the national interest. NSF's annual funding of each STC averages approximately $2.0 million with total funding from all sources including industry averaging about twice the NSF contribution. In 1993, the 25 centers had over 200 industry partners.

Industry/University Cooperative Research Centers & State/Industry/University Cooperative Research Centers

The Industry/University Cooperative Research Centers (I/UCRCs) encourage industrial investment in academic research by developing partnerships in which research is defined by firms supporting each center. NSF currently supports 55 centers involving about 1,800 faculty and students who work with 600 firms across the nation. These centers have spawned a wide range of changes in industrial processes and numerous advances that have resulted in commercially viable products and technologies.

The State/Industry/University Cooperative Research Centers (S/I/UCRCs) seek to enhance local and regional economic development, and actively focus on technology transfer and knowledge deployment. The support of these technology-focused centers is shared by NSF, state governments, and industry. Currently, NSF supports ten centers, in which 168 companies are working with over 600 faculty and students.

Minority Research Centers of Excellence

The goals of the Minority Research Centers of Excellence (MRCE) program are to upgrade and expand the research capabilities of the most productive minority institutions and to increase the number of baccalaureate and doctorate degrees earned by minority students as well as to address research questions requiring a multidisciplinary center-based approach. Institutions with MRCE grants serve as regional research and training centers through interactions and collaborations with other institutions, other NSF and Federal programs, and with the industrial sector.

Materials Research Science and Engineering Centers

The Materials Research Science and Engineering Centers (MRSEC) program supports interdisciplinary materials research addressing fundamental problems of intellectual and strategic importance. MRSECs foster an interactive, interdisciplinary approach by researchers to address problems of a scope or complexity requiring the advantages of scale, facilities, and interdisciplinary breadth provided by a university-based Center. They include active collaboration with industry and other sectors, and support educational outreach to other institutions. The MRSEC Program supersedes the Materials Research Laboratories and Groups programs.

Center For Ecological Analysis and Synthesis

The Center for Ecological Analysis and Synthesis, currently scheduled to be formally established late in FY 1994, will serve as a central repository and clearinghouse for ecological research data, making this previously inaccessible data available to researchers worldwide. The goals of the center will be to bring together groups to produce integrative and comprehensive statements of ecological knowledge that address broad scientific and policy questions; to support individual scientists to produce models and comparative analyses; and to promote efficient, cost-effective use of data from diverse studies in a broad array of disciplines related to ecology including biology, geology, hydrology, climateology, and the social sciences. This center will be coordinated with the Long Term Ecological Research sites.

Earthquake Research Center

The Earthquake Research Center furthers earthquake hazard mitigation through an integrated research and technology transfer program that focuses on the structural and non-structural components of buildings, lifelines (such as power and communications networks), roads, and bridges. It has launched a major new research initiative on civil infrastructure systems to develop guidelines for designing earthquake-resistant highways and bridges and for retrofitting existing systems. Additional funding for the center is provided by other federal agencies and the state of New York.

Long Term Ecological Research Sites

The Long Term Ecological Research Site (LTER) program supports: long-term analysis of ecological phenomena, both natural and human influenced; comparisons of observations across diverse ecosystems; integration of information from multiple sites and multidisciplinary projects through cross-site syntheses; and provision of large, secure, ecologically diverse sites with well-developed support capabilities. Extensive computer modeling allows regional, national and international synthesis efforts.

LTER research can be useful for immediate, practical problems as well as for increasing ecological knowledge. For example, the Sevilleta Long Term Ecological Research (LTER) site in New Mexico evaluates the influence of climate dynamics on rodent populations, plant biodiversity and plant production. The studies documented that population increases of the deer mouse (Peromyscus maniculatus) were responsible for last year's Hantavirus epidemic in the Southwest. Analyses of tissues from mice collected over many years and maintained at the Sevilleta LTER are being used to determine when the new virus became established and to help understand the ecological and climatic factors responsible for the deer mouse infestations.

Critical Technologies Institute

The Critical Technologies Institute is a federally-funded research and development center that provides analytical support to the Executive Branch; policy guidance for the Institute is provided by an external Operating Committee, which functions as the governing board of the institute. The views of U.S. industry, colleges and universities, and Federal and State agencies involved in research and development or utilization of technologies considered critical for U.S. global economic or defense leadership, are analyzed. Through such analyses, the Institute identifies near-term and long-term objectives for research and development; analyzes the production capability and economic viability with respect to such technologies; and provides options for achieving those options.

NSF Centers

FY 1993 DATA

(Dollars in Millions)

	Number of Participating Institutions	Number of Partners	Total NSF Support	Total Leveraged Support	Number of Participants
Engineering Research Centers	28	660	$47.50	$120.00	3,370
Science & Technology Centers	125	206	51.47	51.40	3,297
State and Industry/University Cooperative Research Centers	89	768	6.70	70.50	2,430
Minority Research Centers of Excellence	8	5	7.71	3.30	981
Materials Research Science and Engineering Centers	29	182	38.58	79.40	2,620
Earthquake Research Center	23	16	4.00	6.10	85
Long Term Ecological Research Sites	187	34	10.00	13.30	1,611
Critical Technologies Institute	NA	NA	1.00	NA	NA
TOTAL	489	1871	$166.96	$344.00	14,394

Total Number of Participating Institutions: all academic institutions which participate in activities at the centers.

Number of Partners: the total number of non-academic participants, including industry, states, and other federal agencies, at the centers.

Leveraged Support: funding for centers from sources other than NSF.

Number of Participants: the total number of people who utilize center facilities; not just persons directly supported by NSF.

Centers Supported by the National Science Foundation

	Institution	State
Engineering Research Centers		
Systems Research Center	U of Maryland	MD
Net Shape Manufacturing	Ohio State U	OH
Interfacial Engineering	U of Minnesota	MN
Plasma-Aided Manufacturing	U of Wisconsin	WI
Optoelectronic Computing Systems	U of Colorado	CO
Compound Semiconductor Microelectronics	U of Illinois	IL
Biotechnology Process Engineering	Massachusetts Inst. Tech	MA
Advanced Combustion Engineering	Brigham Young U	UT
Advanced Technology for Large Structural Systems	Lehigh U	PA
Engineering Design	Carnegie Mellon U	PA
Computational Field Simulation	Mississippi State U	MS
Intelligent Manufacturing Systems	Purdue U	IN
Advanced Electronic Materials Processing	North Carolina State U	NC
Data Storage Systems	Carnegie Mellon U	PA
Telecommunications Research	Columbia U	NY
Emerging Cardiovascular Technologies	Duke U	NC
Biofilm Engineering	Montana State U	MT
Offshore Technology	Texas A&M	TX
Science and Technology Centers		
Center for Advanced Cement-Based Materials	Northwestern U	IL
Ultrafast Optical Science	U of Michigan	MI
Advance Liquid Crystalline Optical Materials	Kent State U	OH
Particle Astrophysics	U of California	CA
Molecular Biotechnology	U of Washington	WA
Quantized Electronic Structures	U of California	CA
Astrophysical Research in Antarctica	U of Chicago	IL
Photoinduced Charge Transfer	U of Rochester	NY
Magnetic Resonance Technology for Basic Biological Research	U of Illinois	IL
Computer Graphics and Scientific Visualization	U of Utah	UT
Analysis and Prediction of Storms	U of Oklahoma	OK
Biological Timing	U of Virginia	VA
Center for Research on Parallel Computing	Rice U	TX
Light Microscope Imaging and Biotechnology	Carnegie Mellon U	PA
Clouds, Chemistry, and Climate	U of Chicago	IL
Synthesis, Growth, and Analysis of Electronic Materials	U of Texas	TX
Southern California Earthquake Center	U of Southern California	CA
Computation and Visualization of Geometric Structures	U of Minnesota	MN
Research in Cognitive Science	U of Pennsylvania	PA
Engineering Plants for Resistance Against Pathogens	U of California	CA
Superconductivity	U of Illinois	IL
Discrete Mathematics and Theoretical Computer Science	Rutgers U	NJ
Microbial Ecology	Michigan State U	MI
High Pressure Research	State U of New York	NY
High Performance Polymetric Adhesives and Composites	VA Polytechnic Institute	VA
Industry/University Cooperative Research Centers		
Nondestructive Evaluation	Iowa State U	IA

Manufacturing and Automation Research	U of Southern California	CA
Dimensional Measurement and Control in Manufacturing	U of Michigan	MI
U of MA Industry Research on Polymers	U of Massachusetts	MA
Ceramic Research	Rutgers	NJ
Microcontamination Control	U of Arizona	AZ
Electromagnetics Research	Northeastern U	MA
Engineering Tribology	Northwestern U	IL
Glass Research	NY State College of Ceramics	NY
Center for Microengineered Ceramics	U of New Mexico	NM
Nanostructural Materials Research	U of North Texas	TX
Process Analytical Chemistry	U of Washington	WA
Measurement and Control Engineering Center	U of Tennessee	TN
Building Performance and Diagnostics	Carnegie Mellon U	PA
Advanced Electron Devices and Systems	U of Texas	TX
Ultra-High Speed Integrated Circuits and Systems	U of California	CA
IUCRC for Biosurfaces	State U of New York	NY
Parallel, Distributed, and Intelligent Systems	U of Pittsburgh	PA
Information Management Research	U of Arizona	AZ
Wireless Information Networks	Rutgers	NJ
Hazardous Substance Management	New Jersey Inst. of Tech	NJ
Air Conditioning and Refrigeration Center	U of Illinois	IL
Simulation and Design Optimization of Mechanical Systems	U of Iowa	IA
Aseptic Processing and Packaging Studies	North Carolina State U	NC
Material Handling Research Center	GA Institute of Technology	GA
Web Handling Research Center	Oklahoma State U	OK
Grinding Research & Development	U of Connecticut	CT
Berkeley Sensor & Actuator Center	U of California	CA
Applied Polymer Research	Case Western Reserve U	OH
Dielectric Studies	Pennsylvania State U	PA
Advanced Steel Processing and Products Research Center	Colorado School of Mines	CO
Iron and Steelmaking Research	Carnegie Mellon U	PA
Research Center for Energetic Materials	NM Inst. of Mining & Tech.	NM
Rhode Island Center for Thin Film Interface Research	Brown U	RI
Cooperative Research Center in Coatings	Eastern Michigan U	MI
Polymer Interfaces Center	Lehigh U	PA
Chemical Process Modeling and Control	Lehigh U	PA
Separations Using Thin Films	U of Colorado	CO
Optical Circuitry Cooperative	U of Arizona	AZ
Microwave/Millimeter-wave Computer-aided Design	U of Colorado	CO
Design of Analog-Digital Integrated Circuits	Washington State U	WA
Software Engineering Research Center	Purdue U	IN
Center for Communications and Signal Processing	North Carolina State U	NC
Machine Tools Systems	U of Illinois	IL
Corrosion	Ohio U	OH
Ocean Technology	U of Rhode Island	RI
Composite Design & Manufacturing	Stanford U	CA
Emission Reduction	NJIT	NJ
Biodegradation	U of Massachusetts	MA
High-Speed Image/Signal Processing	U of California	CA
Advanced Communications	Villanova U	PA
Plastics Recycling Research	Rutgers	NJ

Innovation Management Studies	Lehigh	PA
Health Management Research	Arizona State U	AZ
Integrated Pest Management	North Carolina State U	NC

State Industry/University Cooperative Research Centers

Microstructure Composites	Case Western Reserve U	OH
Electronic Packaging	U of Maryland	MD
Intelligent Information Retrieval	U of Massachusetts	MA
Polymer Composite Processing	Michigan State U	MI
Capsule Pipeline for Coal	U of Missouri	MO
Nonwoven Textiles	North Carolina State U	NC
Rock Mechanics	U of Oklahoma	OK
Electronic Imaging	U of Rochester	NY
Electronic Packaging	State U of New York	NY
Biomaterials	U of Texas	TX

Minority Research Centers of Excellence

Analysis of Structures and Interfaces	City College of New York	NY
Cellular and Molecular Biology	Meharry Medical College	TN
Materials Science	U of Texas	TX
Nuclear/High Energy Physics	Hampton U	VA
Nonlinear Optics and Optical Materials	Alabama A&M U	AL
Materials Science	Howard U	Wash D.C.
Tropical and Caribbean Research	U of Puerto Rico	PR
Theoretical Studies of Physical Systems	Clark Atlanta U	GA

Materials Research Science and Engineering Centers

High Pressure Synthesis of Materials	Arizona State U	AZ
Micro-mechanics of Failure-resistant Materials	Brown U	RI
Ultrafast Spectroscopy of Nanostructures	Brown U	RI
Micro-analysis of Hysteresis in Magnetic Media	U California San Diego	CA
Metastable Growth of Diamond and Diamond-like Materials	Case Western Reserve U	OH
Structure, Dynamics, and Transitions in Polymer Liquid Crystals	Case Western Reserve U	OH
Ferroelectric Liquid Crystals	U of Colorado Boulder	CO
Environmental and Stochastic Aspects of Creep Crack Growth	Lehigh U	PA
Absorption, Epitaxy, and Growth: The Roll of Steps	U of Maryland	MD
Studies in Physical Adsorption	Pennsylvania State U	PA
Size Effects in Ferric Solids	Pennsylvania State U	PA
Electronic Transport in Non-Fermi-Liquid Materials	Princeton U	NJ
Microstructured Macromolecular Soft Materials	Princeton U	NJ
Dilute Magnetic Semiconductors and their Superlattices	Purdue U	IN
Grain Boundaries of High Temperature Superconductors	U of Wisconsin	WI
Mechanisms of Film Growth Using Chemical Vapor Deposition	U of Wisconsin	WI
University of Chicago	U of Chicago	IL
Harvard University	Harvard U	MA
Massachusetts Institute of Technology	Mass Inst. of Tech	MA
Northwestern University	Northwestern U	IL
Stanford University	Stanford U	CA
Cornell University	Cornell U	NY
University of Illinois, Urbana/Champain	U of Illinois	IL
University of Massachusetts, Amherst	U of Massachusetts	MA
University of Pennsylvania	U of Pennsylvania	PA
University of California, Santa Barbara	U of California	CA

Earthquake Research Center	State U of New York	NY
Long Term Ecological Research Sites		
Arctic Tundra	Marine Biological Lab	MA
Cedar Creek Natural History Area	U of Minnesota	MN
Coweeta Hydrologic Laboratory	U of Georgia	GA
Hubbard Brook Experimental Forest	Syracuse U	NY
Kellogg Biological Station	Michigan State U	MI
Luquillo Experimental Forest	Inst. of Tropical Forestry	PR
Niwot Ridge-Green Lakes Valley	U of Colorado	CO
Palmer Station, Antarctica	U of California	CA
Virginia Coast Reserve	U of Virginia	VA
H.J Andrews Experimental Forest	Oregon State U	OR
Bonanza Creek Experimental Forest	U of Alaska	AK
Central Plains Experimental Range	Colorado State U	CO
Harvard Forest	Harvard U	MA
Jornada Experimental Range	Duke U	NC
Konza prairie Research Natural Area	Kansas State U	KA
McMurdo Dry Valleys	Desert Research Institute	NV
North Temperate Lakes	U of Wisconsin	WI
Sevilleta National Wildlife Refuge	U of New Mexico	NM
Critical Technologies Institute	RAND Corporation	CA

FACILITIES

The National Science Foundation supports large, multi-user facilities which require long-term commitments for support. These facilities are usually of a scale too large, complex, or expensive for individual or small groups of researchers to construct on their own. They meet the need for multi-user access to state-of-the-art research facilities that would otherwise be unavailable. Support for these unique National facilities is essential to advance U.S. research capabilities required for world class research. Support also includes funding for staff and support personnel to assist scientists in conducting research at the facilities.

NSF supports the following facilities:

(Millions of Dollars)

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate	% Change 94 - 95
Advanced Scientific Computing Centers	65.92	68.07	76.38	12.2%
NSFNET	30.11	41.16	46.16	12.1%
National Center for Atmospheric Research	50.17	51.80	56.49	9.1%
National Astronomy Centers	67.10	65.43	68.73	5.0%
Laser Interferometer Gravitational Wave Observatory	20.00	35.00	50.00	42.9%
National High Magnetic Field Laboratory	14.01	12.00	12.00	0.0%
GEMINI 8-Meter Telescopes	14.07	17.00	20.00	17.6%
National Nanofabrication Users Network	1.85	3.45	3.55	2.9%
Academic Research Fleet/Ship Operations	46.77	49.06	52.55	7.1%
Academic Research Infrastructure	37.28	55.00	27.50	(50.0%)
Polar Facilities	195.38	167.02	167.02	0.0%
Other Facilities*	65.61	69.65	76.45	9.8%
TOTAL	$608.27	$634.64	$656.83	3.5%

*Other facilities include physics, materials research, ocean sciences, upper atmosphere, and earth sciences facilities.

Advanced Scientific Computing Centers

These facilities provide scientists and engineers access to advanced state-of-the-art high performance computers at four national supercomputer centers: San Diego Supercomputer Center, National Center for Supercomputing Applications (University of Illinois), Pittsburgh Supercomputer Center, and Cornell National Supercomputer Facility. The supercomputing centers are dedicated to serving long-term needs, including training for the use of advanced computing by the academic research community. They are also continually updated. Approximately 60% of the funding for these centers is provided by NSF, with the remainder of the funding coming from industry, states, universities and other federal agencies.

NSFNET

The NSFNET enables and expands scholarly communication and collaboration by providing network access for researchers and educators to high performance, remote scientific facilities (including supercomputer centers), and to information resources. This includes support for interconnection of midlevel networks, supercomputer centers, and other federal agency networks. Network connections to midlevel networks from institutions of higher learning, pre-college institutions, and libraries are also supported. With joint funding from other nations, links between NSFNET and research and education networks around the world are supported. Funding is also provided for promising developmental and demonstration networking projects deriving from networking and communications research. NSFNET is the principal network of the federal National Research and Education Network (NREN) program.

National Center for Atmospheric Research (NCAR)

NCAR facilities serve the entire atmospheric sciences research community and part of the ocean sciences community. Facilities available to university, NCAR, and other researchers include a computing center providing supercomputer resources and services emphasizing the development and execution of large models and for the archiving and manipulation of large data sets. NCAR provides research aircraft which can be equipped with sensors to measure meteorological and chemical state parameters, including temperature, pressure, dew point, winds, and ozone. NCAR has recently acquired a Lockheed C-130 which will be used principally for long-range, heavy-lift tropospheric research support. In addition, one airborne and two portable ground-based radars and other surface sensing systems are available for atmospheric research. Roughly 25% of the funding for NCAR facilities is provided by non-NSF sources. In FY 1994 about 1,500 researchers and students utilized NCAR facilities.

National Astronomy Centers

There are three National Astronomy Centers:

The main facility of the National Astronomy and Ionosphere Center (NAIC) is the 305-meter-diameter radio and radar telescope located at Arecibo, Puerto Rico. NAIC is a visitor-oriented National Research Center devoted to scientific investigations in radio and radar astronomy and atmospheric sciences. NAIC provides telescope users with a wide range of research and observing instrumentation, including receivers, transmitters, movable line feeds, and digital data acquisition and processing equipment.

The National Optical Astronomy Observatories (NOAO) is the national center for research in ground-based optical and infrared astronomy. NOAO includes Kitt Peak National Observatory, Cerro Tololo Inter-American Observatory, and the National Solar Observatory. Large optical telescopes, observing equipment, and research support services are made available to qualified scientists.

The National Radio Astronomy Observatory (NRAO) is headquartered at Charlottesville, Virginia, and operates radio telescopes at three sites. NRAO makes radio astronomy facilities available to qualified visiting scientists and provides staff to help them to use the large radio antennas, receivers, and other equipment needed to detect, measure, and identify radio waves from astronomical objects.

Non-NSF sources provide approximately 7% of the funds for the National Astronomy Centers.

Laser Interferometer Gravitational Wave Observatory (LIGO)

LIGO construction began in FY 1992 as a collaboration between physicists and engineers at the California Institute of Technology and the Massachusetts Institute of Technology to test the dynamical features of Einstein's theory of gravitation and to study the properties of intense gravitational fields from their radiation. LIGO consists of two identical, but widely separated detectors (one in Hanford, Washington, and the other in Livingston, Louisiana) that will be used for fundamental physics experiments directly detecting gravitational waves and gathering data on their sources.

National High Magnetic Field Laboratory (NHMFL)

Construction began in FY 1991 on the NHMFL to keep the U.S. at the forefront of high magnetic field research. Research using high magnetic fields has played a key role in the advancement of our knowledge of the physical, chemical, biological and engineering properties of materials. The NHMFL, located at Florida State University, is expected to be fully operational in 1995. Approximately 25% of NHMFL funds are provided by non-NSF sources.

GEMINI 8-Meter Telescopes

The Gemini Telescopes Project will construct two 8-meter telescopes, one in Hawaii and one in Chile. Funded through international collaboration, these new generation optical/infrared telescopes have a significantly larger aperture than existing instruments, allowing for better sensitivity, spectral and spatial resolution.

National Nanofabrication Users Network

NSF provides support for research on the fundamental phenomena and processes underlying nanostructures technology and micro-electromechanical systems. To support the national infrastructure needs for these burgeoning research fields, NSF has established the National Nanofabrication Users Network (NNUN), a network of university-based user facilities that will offer advanced nano- and micro-fabrication capabilities to researchers in academe, industry, and government.

Academic Research Fleet/Ship Operations

Oceanographic facilities include ships, submersibles and large shipboard equipment necessary to support NSF-funded research and the training of oceanographers. Twenty-six ships are included in the U.S. academic fleet, operated on behalf of the research community, primarily through NSF funds. Large ships are used for distant-water, expeditionary projects such as global change research; intermediate-sized ships support individual investigator research; and smaller regional ships are available for local and coastal research. Special purpose ships are used for submersible and remotely operated vehicle studies.

Academic Research Infrastructure

The facilities modernization component of the Academic Research Infrastructure program aims to improve the Nation's research infrastructure through focused investment in the revitalization of facilities used for research and research training. Activities encompassed include repair or renovation, or in exceptional cases, replacement of scientific or engineering research and research training facilities. Modernization is focused on facilities at institutions of higher education, independent nonprofit research institutions, and research museums. Assistance is also specifically provided for graduate and undergraduate institutions that historically have received limited Federal research and development funds to enable them to improve their academic science and engineering infrastructure.

Polar Facilities

Polar facilities make research possible in the remote and hazardous Antarctic continent, where all infrastructure must be provided. Three research stations are maintained -- McMurdo, South Pole and Palmer. Other facilities include ski-equipped aircraft, helicopters, research vessels (including a specially constructed ice-breaking research vessel), and an ice-breaking supply and support ship. Logistical support for polar facilities is supplied in part by DOD. In FY 1995 about 600 researchers and students will utilize the Polar facilities.

EDUCATION AND TRAINING

The National Science Foundation places a high priority on science, mathematics, engineering, and technology education. These efforts focus on a number of areas related to National Education Goals:

- enabling U.S. students to become well-informed, scientifically literate citizens
- ensuring an adequate, well-trained workforce
- maintaining U.S. leadership in science and technology

Much of NSF support is associated with interagency Science, Math, Engineering and Technology Education efforts. NSF's programs cover all education levels: pre-kindergarten through secondary; undergraduate; graduate (both pre- and post-doctoral study); and public science literacy. In addition, special emphasis is placed on groups which have been historically underrepresented in science and engineering fields, namely women, minorities, and persons with disabilities. Other important NSF education and training efforts include programs for evaluation and dissemination, which ensure that education programs achieve their goals and that program and project outcomes reach a wide audience. Education and training totals below include both Education and Human Resources and Research and Related Activities appropriations.

(Millions of Dollars)

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate	% Change FY 94 - 95
K-12	303.09	351.72	360.59	2.5%
Undergraduate	151.55	180.06	189.60	5.3%
Graduate/Postdoctoral	101.60	87.33	94.03	7.7%
Young Investigators	64.44	64.36	64.88	0.8%
EPSCOR	24.65	31.92	31.92	0.0%
Other Education and Training Support	35.41	35.60	36.19	1.7%
TOTAL	$680.74	$750.99	$777.21	3.5%

K-12

The goal of NSF's programs at the K-12 level is for all students to succeed in mathematics, science, and technology. To accomplish this goal, NSF programs are directed at teachers, students, curriculum development, and systemic reform. Teacher enhancement and teacher preparation programs strengthen teachers' knowledge and pedagogical skills and create a network of teachers who are better able to foster reform. The Young Scholars Program recognizes outstanding precollege students and provides research and networking opportunities. K-12 curricula are enhanced through the instructional materials development program. In addition, NSF's systemic reform efforts aim to make lasting improvements in science, mathematics, and technology education at the state level, in urban centers, and in rural regions. The systemic approach involves broad partnerships in the development of goals, solutions, and actions.

The FY 1995 budget request includes a $1.00 million increase at the K-12 for support of the Advanced Technological Education program. In FY 1995, systemic reform activities are increased by $8.00 million to $86.06 million, including increases of $6.00 million for the Urban Systemic Initiative and $2.00 million for the Rural Systemic Initiative. Other K-12 activities are maintained at their FY 1994 levels.

Undergraduate

NSF's programs support many facets of undergraduate education, including instrumentation and laboratory improvement, curriculum development, and undergraduate student research. In order to improve the quality of undergraduate courses and curricula in the sciences, NSF provides money to encourage the development of multi- and interdisciplinary courses as well as encourage science, mathematics, and engineering faculty members to take leadership in developing educational experiences that enhance the competence of prospective teachers.

NSF programs which address undergraduate needs include:

- Research Experiences for Undergraduates (REU), which provides opportunities for undergraduates to gain valuable scientific research experiences,
- Research in Undergraduate Institutions (RUI), which provides support for research and research equipment for faculty located in nondoctoral departments in predominantly undergraduate institutions,
- Engineering Education Coalitions, which stimulate innovative and comprehensive models for systemic reform of undergraduate engineering education and aim to increase the retention of students,
- Instrumentation and laboratory improvement projects, which develop new or improved laboratory courses or experiments in the sciences and also support matching grants for instructional instrumentation,
- Alliances for Minority Participation, which supports comprehensive approaches to increase the quantity and quality of underrepresented minorities who successfully earn science and engineering baccalaureate degrees, and the number who go on for graduate study in these fields, and
- Minority Research Centers of Excellence, which seek to increase the number of minorities in science and engineering by making substantial resources available to upgrade the capabilities of the most research-productive minority institutions.

In order to meet the demands for a highly-skilled, competitive technological workforce, the Advanced Technological Education program was established to focus on educating technicians for the high performance workplace. The initiative will target technician education programs at the undergraduate and secondary school levels in advanced technology fields by promoting and supporting curriculum development and program improvement.

Undergraduate activities will total almost $190.00 million in FY 1995, an increase of $9.54 million over the FY 1994 estimate. Engineering Education Coalitions will increase by $3.00 million in FY 1995 for a total of $18.00 million. The Advanced Technological Education initiative will increase at the undergraduate level by $2.00 million for a total of $11.77 million. Other undergraduate programs with increases in FY 1995 include REU, RUI, and course and curriculum development.

Graduate/Postdoctoral

NSF's graduate education programs are designed to improve the human resource base of science and engineering in the United States and to increase the number of minority scientists and engineers who are traditionally underrepresented in advanced levels of science, mathematics, and engineering. Programs include:

- Graduate Fellowships and Minority Graduate Fellowships, which are awarded across all science, mathematics, and engineering disciplines to provide financial support for outstanding students during their graduate studies,
- Graduate Research Traineeships, which are awarded competitively to institutions and provide student support in critical areas of current and anticipated national priority,
- Research Training Groups which foster multidisciplinary, research-based training and education at the graduate level,
- Visiting Professorships for Women, which provide support to experienced women scientists and engineers who serve as visiting faculty members at host institutions, and

- Postdoctoral study and research fellowships, which are sponsored in specific research disciplines.

Graduate and postdoctoral programs will total $94.03 million, an increase of $6.70 million over FY 1994. Included in this amount is an increase of $4.60 million for graduate research fellowships, which will allow for modest increases in both the stipend and the cost of education allowance. Additional opportunities for graduate and postdoctoral training is provided through support for research projects. This amount is expected to total $16.50 million in FY 1995, an increase of $2.1 million over FY 1994.

Young Investigators

NSF has developed programs to recognize and support scientists and engineers at early stages in their careers. NSF Young Investigator (NYI) awards encourage the development of future academic leaders in science and engineering, both in teaching and research. NYI promotes cooperation between academia and industry by encouraging matching support from industry for these awards. Presidential Faculty Fellow (PFF) awards support the scholarly activities of young science and engineering faculty members by allowing them to undertake self-designed, innovative research and teaching projects, establish research and teaching programs, and pursue other academic-related activities.

Funding for Young Investigators programs total $64.88 million in FY 1995.

EPSCoR

The Experimental Program to Stimulate Competitive Research (EPSCoR) is designed to strengthen science and engineering research at academic institutions in participant states. This improvement should increase these states' research capability and their overall research and development competitiveness. The awards assist states and universities in identifying individuals and institutions capable of producing short-term project outcomes and long-term systemic change. Eighteen states and the Commonwealth of Puerto Rico are currently eligible to participate in EPSCoR.

Funding for EPSCoR will be sustained at the current levels of $31.92 million after significant growth in FY 1994.

Other Education and Training Support

NSF also supports programs for public science literacy and groups traditionally underrepresented in science and engineering fields. These include informal science education and programs for women and minority faculty and minority institutions.

NUMBERS OF PEOPLE INVOLVED IN NSF ACTIVITIES

Almost 150,000 people are directly involved in NSF programs and activities, receiving salaries, stipends, or participant support.

In addition, an estimated 10 million people are indirectly impacted by NSF programs. These programs reach K-12 students, K-12 teachers, and researchers through activities including workshops; informal science activities such as museums, television, and videos; outreach efforts; and dissemination of improved curriculum and teaching methods.

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Senior Researchers	23,000	24,800	25,800
Other Professionals	7,900	8,400	8,700
Postdoctoral Associates	4,300	4,500	4,900
Graduate Students	19,600	20,700	21,300
Undergraduate Students	11,400	13,700	14,100
K-12 Teachers	46,200	55,200	59,500
K-12 Students	11,100	12,900	12,900
Total Number of People	123,500	140,200	147,200

Categories of people participating directly in NSF programs are described below.

Senior Researchers include scientists, mathematicians, engineers, and educators receiving funding through NSF awards. These include both researchers who are principal or co-principal investigators on research and education projects, and researchers working at NSF-supported centers and facilities.

Other Professionals are individuals who may or may not hold a doctoral degrees or its equivalent who are considered professionals, but are not reported as senior researchers, postdoctoral associates, or students. Examples are technicians, systems experts, etc.

Postdoctoral Associates are individuals who have received Ph.D., M.D., D.Sc., or equivalent degrees less than five years ago, and who are not members of the faculty of the performing institution. Most of these postdoctoral associates are supported through funds included in research projects, centers or facilities awards. The balance of these, less than 5 percent, are recipients of postdoctoral felllowships.

Graduate Students include students compensated from NSF grant funds. Roughly 15 percent of these students receive support through programs such as the NSF Graduate Fellowships, Minority Graduate Fellowships, and Graduate Traineeships. The balance assist senior researchers or postdoctoral associates in performing research, and are supported through funds included in research projects, centers or facilities awards.

Undergraduate Students include students enrolled in technical colleges or baccalaureate programs compensated from NSF grant funds. They may either be assisting senior researchers or postdoctoral associates in performing research, or participating in NSF programs specifically aimed at undergraduate students, such as Research Experiences for Undergraduates or Alliances for Minority Participation.

K-12 Teachers include teachers at elementary, middle and secondary schools. These teachers participate in a direct, intensive enhancement project, which includes approximately three week programs with follow-up activities.

K-12 Students are those attending elementary, middle and secondary schools. These students receive direct support in NSF programs, such as the Young Scholars program and the Summer Science Camps.

NSF FUNDING PROFILE

Approximately half of the awards that are supported in a particular fiscal year are competitively reviewed in that year through NSF's merit review process. The other awards are continuations of projects that were competitively reviewed in a prior year. The funding rate is the number of competitive awards made during a year as a percentage of total proposals competitively reviewed. It indicates the probability of winning an award when submitting proposals to NSF.

The annualized award size displays the annual level of support provided to awardees by dividing the total dollars of each award by the number of years over which it extends. Both the average and the median annualized award size for competitively reviewed awards are shown.

Average duration is the length of the award in years. The duration calculation is limited to research projects and excludes other categories of awards which fund infrastructure-type activities such as equipment and conference awards which do not require multi-year support.

The Quantitative Data Tables provided under a separate tab are based on all proposals and awards, including competitive awards, contracts, cooperative agreements, supplements and amendments to existing grants and contracts.

NSF FUNDING PROFILE

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Total Number of Awards	18,216	19,100	19,500
Statistics for Competitive Awards:			
Number	9,022	9,300	9,600
Funding Rate	30%	30%	30%
Median Annualized Award Size	$50,000	$53,300	$56,900
Average Annualized Award Size	$82,832	$89,800	$91,500
Average Duration (yrs.) \1	2.7	2.8	2.8

1\ Average Duration includes research projects only.

CHANGES IN BUDGET STRUCTURE

As part of an Administration effort to reduce the administrative burden associated with maintaining a large number of separate appropriations, merger of the U.S. Polar Research Programs, U.S. Antarctic Logistical Support Activities, and Critical Technologies Institute appropriations into the Research and Related Activities appropriation is proposed for FY 1995. This change will reduce the effort associated with preparation of accounting and budget schedules without adversely affecting administrative control and accountability.

A new appropriation, Major Research Equipment, has been created to provide for the construction of major research facilities and equipment that provide unique capabilities at the cutting edge of science and engineering. This action will improve our ability to manage, budget and account for these projects. Projects funded from this appropriation are funded through the Research and Related Activities appropriation in FY 1994.

A crosswalk showing these changes in budget structure is provided below.

NATIONAL SCIENCE FOUNDATION BUDGET STRUCTURE
FY 1995 REQUEST
(Dollars in Thousands)

	New Structure							
Old Structure	Research and Related Activities	Education and Human Resources	Academic Research Infrastructure	Major Research Equipment	Salaries & Expenses	NSF Headquarters Relocation	Office of Inspector General	**Total, Old Structure**
Research and Related Activities	2,121,270			70,000				**$2,191,270**
Education and Human Resources		586,000						**$586,000**
U.S Polar Research Programs	162,830							**$162,830**
U.S Antarctic Logistics Activities	62,600							**$62,600**
Academic Research Infrastructure			55,000					**$55,000**
Critical Technologies Institute	2,000							**$2,000**
Salaries and Expenses					130,720			**$130,720**
NSF Headquarters Relocation						5,200		**$5,200**
Office of Inspector General							4,380	**$4,380**
Total, New Structure	**$2,348,700**	**$586,000**	**$55,000**	**$70,000**	**$130,720**	**$5,200**	**$4,380**	**$3,200,000**

FY 95 APPROPRIATION LANGUAGE

National Science Foundation

RESEARCH AND RELATED ACTIVITIES

For necessary expenses in carrying out the purposes of the National Science Foundation Act of 1950, as amended (42 U.S.C. 1861-1875), [and] the Act to establish a National Medal of Science (42 U.S.C. 1880-1881), *and section 822 of the National Defense Authorization Act for fiscal year 1991, as amended (42 U.S.C. 6686)*; services as authorized by 5 U.S.C. 3109; maintenance and operation of aircraft and purchase of flight services for research support; acquisition of aircraft; [$1,986,000,000], *$2,348,700,000, of which not to exceed $227,430,000 shall remain available until expended for the Critical Technologies Institute, Polar research and operations support, and for reimbursement to other Federal agencies for operational and science support and logistical and other related activities for the United States Antarctic program; the balance* to remain available until September 30, [1995]: *1996 Provided*, That receipts for scientific support services and materials furnished by the National Research Centers and other National Science Foundation supported research facilities may be credited to this appropriation: *Provided further*, That to the extent that the amount appropriated is less than the total amount authorized to be appropriated for included program activities, all amounts, including floors and ceilings, specified in the authorizing Act for those program activities or their subactivities shall be reduced proportionally: *Provided further*, That [none of the funds made available under this heading may be used to acquire through lease, purchase or other means an arctic research vessel] *amounts appropriated in prior fiscal years for the United States Polar Research Programs, the United States Antarctic Logistical Support Activities, and the Critical Technologies Institute shall be transferred to and merged with this appropriation and remain available until expended. (Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations Act, 1994.)*

EDUCATION AND HUMAN RESOURCES ACTIVITIES

For necessary expenses in carrying out science and engineering education and human resources programs and activities pursuant to the purposes of the National Science Foundation Act of 1950, as amended (42 U.S.C. 1861-1875), including services as authorized by 5 U.S.C. 3109 and rental of conference rooms in the District of Columbia, [$569,600,000] *$586,000,000*, to remain available until September 30, [1995] *1996: Provided*, That to the extent that the amount of this appropriation is less than the total amount authorized to be appropriated for included program activities, all amounts, including floors and ceilings, specified in the authorizing Act for those program activities or their subactivities shall be reduced proportionally. *(Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations Act, 1994.)*

[UNITED STATES POLAR RESEARCH]

[For necessary expenses in carrying out arctic and antarctic research and operational support and for reimbursement to other Federal agencies for operational and science support and other related activities for the United States Antarctic program and the Arctic research program pursuant to the National Science Foundation Act of 1950, as amended (42 U.S.C. 1861-1875); maintenance and operation of aircraft and purchase of flight services for research and operations support; improvement of environmental practices and enhancements of safety; services as authorized by 5 U.S.C. 3109; maintenance and operation of research ships and charter or lease of ships for research and operations support; hire of passenger motor vehicles; not to exceed $2,500 for official reception and representation expenses; $158,100,000, to remain available until expended: *Provided*, That receipts for support services and materials provided for non-Federal activities may be credited to this appropriation: *Provided further*, That none of the funds made available under this heading may be used to enter into a new charter or lease for the use of a research vessel refurbished or modernized in a foreign shipyard or of a newly-constructed research vessel built in a foreign shipyard.] *(Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations Act, 1994.)*

[UNITED STATES ANTARCTIC LOGISTICAL SUPPORT ACTIVITIES]

[For necessary expenses in reimbursing Federal agencies for logistical and other related activities for the United States Antarctic program pursuant to the National Science Foundation Act of 1950, as amended (42 U.S.C. 1861-1875); acquisition, maintenance, and operation of aircraft for research and operations support; improvement of environmental practices and enhancements of safety; $62,600,000, to remain available until expended: *Provided*, That receipts for support services and materials provided for non-Federal activities may be credited to this appropriation.] *(Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations Act, 1994.)*

ACADEMIC RESEARCH [FACILITIES AND INSTRUMENTATION] INFRASTRUCTURE

For necessary expenses in carrying out an academic research [facilities and instrumentation] *infrastructure* program pursuant to the purposes of the National Science Foundation Act of 1950, as amended (42 U.S.C. 1861-1875), including services as authorized by 5 U.S.C. 3109 and rental of conference rooms in the District of Columbia, [$100,000,000] *$55,000,000,* to remain available until September 30, [1995] *1996*. *(Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations Act, 1994.)*

SALARIES AND EXPENSES

For necessary salaries and expenses in carrying out the purposes of the National Science Foundation Act of 1950, as amended (42 U.S.C. 1861-1875); services authorized by 5 U.S.C. 3109; hire of passenger motor vehicles; not to exceed [$6,000] *$9,000* for official reception and representation expenses; uniforms or allowances therefore, as authorized by law (5 U.S.C. 5901-5902); [rental of conference rooms in the District of Columbia;] reimbursement of the General Services Administration for security guard services; [$118,300,000] *$130,720,000. Provided*, That contracts may be entered into under salaries and expenses in fiscal year [1994] *1995* for maintenance and operation of facilities, and for other services, to be provided during the next fiscal year. *(Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations Act, 1994.)*

OFFICE OF INSPECTOR GENERAL

For necessary expenses of the Office of Inspector General in carrying out the provisions of the Inspector General Act of 1978, as amended, [$3,997,000] *$4,380,000*, to remain available until September 30, [1995] *1996*. *(Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations Act, 1994.)*

NATIONAL SCIENCE FOUNDATION HEADQUARTERS RELOCATION

For necessary support of the relocation of the National Science Foundation, $5,200,000 to remain available until expended: *Provided*, That these funds shall be used to reimburse the General Services Administration for services and related acquisitions in support of relocating the National Science Foundation. *(Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations Act, 1994.)*

[CRITICAL TECHNOLOGIES INSTITUTE]

[For necessary expenses for support of the Critical Technologies Institute as authorized by Section 822 of the National Defense Authorization Act for Fiscal Year 1991, as amended (42 U.S.C. 6686), $1,500,000, to remain available until expended.] *(Departments of Veterans Affairs and Housing and Urban Development and Related Agencies Appropriations Act, 1994.)*

SUMMARY OF FY 1995 BUDGET BY APPROPRIATION AND ACTIVITY

(DOLLARS IN THOUSANDS)

	FY 1993 ACTUAL	FY 1994 REQUEST	FY 1994 CURRENT PLAN	FY 1995 REQUEST	CHANGE FY 95 Req/FY 94 CP AMOUNT	CHANGE FY 95 Req/FY 94 CP PERCENT
RESEARCH AND RELATED ACTIVITIES /1						
Biological Sciences	$271,324	$311,910	$288,780	$313,940	$25,160	8.7%
Computer and Information Science and Engineering	$215,603	$296,010	$240,580	$273,500	$32,920	13.7%
Engineering	$256,054	$323,050	$295,170	$320,410	$25,240	8.6%
Geosciences	$381,602	$448,530	$403,870	$443,090	$39,220	9.7%
Mathematical and Physical Sciences	$585,856	$658,390	$619,850	$657,720	$37,870	6.1%
Social, Behavioral and Economic Sciences	$90,669	$106,910	$98,250	$112,610	$14,360	14.6%
U.S. Polar Research Programs	$180,777	$163,100	$158,100	$162,830	$4,730	3.0%
U.S. Antarctic Logistical Support Activities	$63,429	$65,100	$62,600	$62,600	$0	0.0%
Critical Technologies Institute	$1,000	$1,000	$1,500	$2,000	$500	33.3%
Major Research Equipment	$34,070	$60,000	$52,000	$0	($52,000)	(100.0%)
Subtotal	$2,080,384	$2,434,000	$2,220,700	$2,348,700	$128,000	5.8%
Unobligated Balance Available Start of Year	($4,022)	$0	$0	$0	$0	
Unobligated Balance Available End of Year	$5,527	$0	$0	$0	$0	
Adjustments to Prior Year Accounts	($1,119)	$0	$0	$0	$0	
Unobligated Balance Lapsing	$590	$0	$0	$0	$0	
TOTAL	$2,081,360	$2,434,000	$2,220,700	$2,348,700	$128,000	5.8%
EDUCATION AND HUMAN RESOURCES						
Systemic Reform	$82,287	$102,980	$109,980	$117,980	$8,000	7.3%
Elementary, Secondary and Informal Education	$184,684	$197,950	$198,280	$199,280	$1,000	0.5%
Undergraduate Education	$61,907	$74,840	$81,010	$83,010	$2,000	2.5%
Graduate Education and Research Development	$85,416	$66,460	$66,460	$71,060	$4,600	6.9%
Human Resource Development	$49,613	$65,890	$66,390	$66,390	$0	0.0%
Research, Evaluation and Dissemination	$41,156	$47,980	$47,480	$48,280	$800	1.7%
Subtotal	$505,063	$556,100	$569,600	$586,000	$16,400	2.9%
Unobligated Balance Available Start of Year	($24,074)	$0	$0	$0	$0	
Unobligated Balance Available End of Year	$7,077	$0	$0	$0	$0	
Adjustments to Prior Year Accounts	($816)	$0	$0	$0	$0	
Unobligated Balance Lapsing	$250	$0	$0	$0	$0	
TOTAL	$487,500	$556,100	$569,600	$586,000	$16,400	2.9%
ACADEMIC RESEARCH INFRASTRUCTURE	$49,754	$55,000	$100,000 /2	$55,000	($45,000)	(45.0%)
Unobligated Balance Available Start of Year	($374)	$0	$0	$0	$0	
Unobligated Balance Available End of Year	$620	$0	$0	$0	$0	
Adjustments to Prior Year Accounts	$0	$0	$0	$0	$0	
Unobligated Balance Lapsing	$0	$0	$0	$0	$0	
TOTAL	$50,000	$55,000	$100,000	$55,000	($45,000)	(45.0%)
MAJOR RESEARCH EQUIPMENT /3	$0	$0	$0	$70,000	$70,000	N/A

SUMMARY OF FY 1995 BUDGET BY APPROPRIATION AND ACTIVITY

(DOLLARS IN THOUSANDS)

	FY 1993 ACTUAL	FY 1994 REQUEST	FY 1994 CURRENT PLAN	FY 1995 REQUEST	CHANGE FY 95 Req/FY 94 CP AMOUNT	CHANGE FY 95 Req/FY 94 CP PERCENT
SALARIES AND EXPENSES	$110,838	$125,800	$118,300	$130,720	$12,420	10.5%
Unobligated Balance Available						
Start of Year	$0	$0	$0	$0	$0	
Unobligated Balance Available						
End of Year	$0	$0	$0	$0	$0	
Adjustments to Prior Year Accounts	$0	$0	$0	$0	$0	
Unobligated Balance Lapsing	$162	$0	$0	$0	$0	
TOTAL	$111,000	$125,800	$118,300	$130,720	$12,420	10.5%
NSF HEADQUARTERS RELOCATION	$0	$5,200	$5,200	$5,200	$0	0.0%
OFFICE OF INSPECTOR GENERAL	$3,687	$4,100	$3,997	$4,380	$383	9.5%
Unobligated Balanced Available						
Start of Year	$0	$0	$0	$0	$0	
Unobligated Balanced Available						
End of Year	$0	$0	$0	$0	$0	
Adjustments to Prior Year Accounts	$0	$0	$0	$0	$0	
Unobligated Balance Lapsing	$1	$0	$0	$0	$0	
TOTAL	$3,688	$4,100	$3,997	$4,380	$383	9.5%
SUBTOTAL, NSF	$2,733,548	$3,180,200	$3,017,797	$3,200,000	$182,203	6.0%
Carryover	$0	$0	$13,224	$0	($13,224)	
TOTAL, NATIONAL SCIENCE FOUNDATION	$2,733,548	$3,180,200	$3,031,021	$3,200,000	$168,979	5.6%

1/ Displays proposed merger of Research and Related Activities, U.S. Polar Research Programs, U.S. Antarctic Logistics, and Critical Technologies Institute appropriations into the Research and Related Activities appropriation

2/ FY 1994 Current Plan for Academic Research Infrastructure excludes $10 million as proposed for rescission.

3/ The Major Research Equipment appropriation is proposed in FY 1995 to fund the construction of major research equipment currently funded through the Research and Related Activities appropriation

LEVEL OF FUNDING BY PROGRAM

(Dollars in Thousands)

PROGRAM ELEMENT	FY 1993 ACTUAL	FY 1994 REQUEST	FY 1994 CURRENT PLAN	FY 1995 REQUEST	CHANGE FY 95 Req/FY 94 CP AMOUNT	CHANGE FY 95 Req/FY 94 CP PERCENT
BIOLOGICAL SCIENCES						
MOLECULAR AND CELLULAR BIOSCIENCES						
Biochemistry and Molecular Structure and Function	$32,728	$37,100	$33,850	$36,050	$2,200	6.5%
Cell Biology	19,284	21,750	19,890	21,450	1,560	7.8%
Genetics and Nucleic Acids	29,126	34,460	31,350	33,550	2,200	7.0%
Total	81,138	93,310	85,090	91,050	5,960	7.0%
INTEGRATIVE BIOLOGY AND NEUROSCIENCES						
Physiology and Behavior	28,648	33,510	30,520	33,310	2,790	9.1%
Neuroscience	30,808	34,690	31,310	33,100	1,790	5.7%
Developmental Biology	14,822	17,780	16,040	17,310	1,270	7.9%
Total	74,278	85,980	77,870	83,720	5,850	7.5%
ENVIRONMENTAL BIOLOGY						
Systematic and Population Biology	22,059	25,400	23,740	26,040	2,300	9.7%
Ecological Studies	23,800	28,820	26,160	27,960	1,800	6.9%
Long-term Projects in Environmental Biology	24,305	27,170	24,900	29,300	4,400	17.7%
Total	70,164	81,390	74,800	83,300	8,500	11.4%
BIOLOGICAL INSTRUMENTATION AND RESOURCES						
Instrumentation and Instrument Development	13,586	14,850	14,790	15,790	1,000	6.8%
Special Projects	32,158	36,380	36,230	40,080	3,850	10.6%
Total	45,744	51,230	51,020	55,870	4,850	9.5%
Total, BIO	$271,324	$311,910	$288,780	$313,940	$25,160	8.7%

LEVEL OF FUNDING BY PROGRAM (continued)

(Dollars in Thousands)

PROGRAM ELEMENT	FY 1993 ACTUAL	FY 1994 REQUEST	FY 1994 CURRENT PLAN	FY 1995 REQUEST	CHANGE FY 95 Req/FY 94 CP AMOUNT	CHANGE FY 95 Req/FY 94 CP PERCENT
COMPUTER AND INFORMATION SCIENCE AND ENGINEERING						
COMPUTER AND COMPUTATION RESEARCH						
Theory of Computing	8,541	10,040	9,085	10,145	1,060	11.7%
Numeric, Symbolic & Geometric Computation	6,071	9,200	7,010	7,720	710	10.1%
Computer Systems	3,880	5,320	4,125	4,505	380	9.2%
System Software	11,962	15,350	12,680	14,000	1,320	10.4%
Software Engineering	4,326	6,160	4,760	5,540	780	16.4%
Total	34,780	46,070	37,660	41,910	4,250	11.3%
INFORMATION, ROBOTICS AND INTELLIGENT SYSTEMS						
Knowledge and Database System	11,888	18,210	13,130	14,780	1,650	12.6%
Robotics and Machine Intelligence	6,291	9,150	7,100	8,350	1,250	17.6%
Interactive Systems	4,674	6,860	4,800	5,900	1,100	22.9%
Information Technology and Organizations	4,127	6,400	4,800	5,700	900	18.8%
Total	26,980	40,620	29,830	34,730	4,900	16.4%
MICROELECTRONIC INFORMATION PROCESSING SYSTEMS						
Design, Tools and Test	4,161	5,840	4,440	5,140	700	15.8%
Microelectronic Systems Architecture	3,871	5,480	4,175	4,775	600	14.4%
Circuits and Signal Processing	4,176	5,780	4,445	4,945	500	11.2%
Experimental Systems	7,074	10,610	7,820	9,120	1,300	16.6%
Systems Prototyping and Fabrication	2,303	5,120	2,900	3,600	700	24.1%
Total	21,585	32,830	23,780	27,580	3,800	16.0%
ADVANCED SCIENTIFIC COMPUTING						
Centers	65,916	80,370	69,860	78,470	8,610	12.3%
New Technologies	4,098	10,900	5,000	6,700	1,700	34.0%
Total	70,014	91,270	74,860	85,170	10,310	13.8%
NETWORKING AND COMMUNICATIONS RESEARCH AND INFRASTRUCTURE						
NSFNET	30,107	43,190	41,163	46,663	5,500	13.4%
Networking & Communications Research	9,796	11,750	10,297	11,597	1,300	12.6%
Total	39,903	54,940	51,460	58,260	6,800	13.2%
CROSS-DISCIPLINARY ACTIVITIES						
CISE Institutional Infrastructure	18,835	25,740	19,430	21,890	2,460	12.7%
CISE Instrumentation	3,506	4,540	3,560	3,960	400	11.2%
Total	22,341	30,280	22,990	25,850	2,860	12.4%
Total, CISE	$215,603	$296,010	$240,580	$273,500	$32,920	13.7%

LEVEL OF FUNDING BY PROGRAM (continued)

(Dollars in Thousands)

PROGRAM ELEMENT	FY 1993 ACTUAL	FY 1994 REQUEST	FY 1994 CURRENT PLAN	FY 1995 REQUEST	CHANGE FY 95 Req/FY 94 CP AMOUNT	PERCENT
ENGINEERING						
BIOENGINEERING AND ENVIRONMENTAL SYSTEMS						
Bioengineering	$14,582	$18,154	$16,000	$17,100	$1,100	6.9%
Environmental and Ocean Systems	5,839	6,590	$6,130	6,430	300	4.9%
Total	20,421	24,744	22,130	23,530	1,400	6.3%
CHEMICAL AND TRANSPORT SYSTEMS						
Chemical Reaction Processes	9,302	11,393	9,900	10,200	300	3.0%
Interfacial, Transport and Separations Processes	8,622	10,254	9,220	9,560	340	3.7%
Fluid, Particulate and Hydraulic Systems	9,187	10,782	9,900	10,210	310	3.1%
Thermal Systems	7,360	9,841	8,050	8,400	350	4.3%
Total	34,471	42,270	37,070	38,370	1,300	3.5%
DESIGN, MANUFACTURE, AND INDUSTRIAL INNOVATION						
Operations Research and Production Systems	5,730	8,345	7,680	7,950	270	3.5%
Design and Integration Engineering	5,373	8,295	7,560	7,860	300	4.0%
Manufacturing Processes and Equipment	10,436	16,160	14,460	15,040	580	4.0%
Small Business Innovation Research	23,008	33,120	31,200	42,310	11,110	35.6%
Management of Technological Innovation	503	1,300	1,500	1,500	0	0.0%
Special Studies and Assessments	1,153	1,470	1,400	1,400	0	0.0%
Industry/University Liaison	0	1,000	2,800	3,800	1,000	35.7%
Total	46,203	69,690	66,600	79,860	13,260	19.9%
ELECTRICAL AND COMMUNICATIONS SYSTEMS						
Quantum Electronics, Waves and Beams	9,213	11,714	10,040	10,590	550	5.5%
Solid State and Microstructures	10,482	12,764	11,410	11,770	360	3.2%
Communications and Computational Systems	5,208	6,837	6,570	7,840	1,270	19.3%
Engineering Systems	8,067	10,405	8,950	9,150	200	2.2%
Emerging Technologies Initiation	1,149	1,100	0	0	0	N/A
Total	34,119	42,820	36,970	39,350	2,380	6.4%
ENGINEERING EDUCATION AND CENTERS						
Engineering Education	15,402	18,400	18,300	21,800	3,500	19.1%
Human Resources Development	11,441	12,610	11,030	11,530	500	4.5%
Engineering Research Centers	47,500	52,500	51,500	51,500	0	0.0%
Industry/University Cooperative Research Centers	6,701	9,200	7,850	7,850	0	0.0%
Total	81,044	92,710	88,680	92,680	4,000	4.5%
CIVIL AND MECHANICAL SYSTEMS						
Earthquake Hazard Mitigation	13,611	17,482	15,000	16,230	1,230	8.2%
Natural and Technological Hazard Mitigation	2,584	3,194	2,610	2,830	220	8.4%
Dynamic Systems and Control	3,792	4,867	4,200	4,390	190	4.5%
Structures, Geomechanics and Building Systems	8,658	10,954	9,510	10,100	590	6.2%
Surface Engineering and Tribology	2,516	3,366	2,840	2,970	130	4.6%
Mechanics and Materials	8,635	10,953	9,560	10,100	540	5.6%
Total	39,796	50,816	43,720	46,620	2,900	6.6%
Total, ENG	$256,054	$323,050	$295,170	$320,410	$25,240	8.6%

LEVEL OF FUNDING BY PROGRAM (continued)

(Dollars in Thousands)

PROGRAM ELEMENT	FY 1993 ACTUAL	FY 1994 REQUEST	FY 1994 CURRENT PLAN	FY 1995 REQUEST	CHANGE FY 95 Req/FY 94 CP AMOUNT	CHANGE FY 95 Req/FY 94 CP PERCENT
GEOSCIENCES						
ATMOSPHERIC SCIENCES						
Atmospheric Sciences Project Support	$69,439	$81,930	$75,470	$83,650	$8,180	10.8%
National Center for Atmospheric Research	50,171	59,240	51,800	56,490	4,690	9.1%
Upper Atmospheric Facilities	6,888	7,930	7,100	7,730	630	8.9%
Total	126,498	149,100	134,370	147,870	13,500	10.0%
EARTH SCIENCES						
Earth Sciences Project Support	51,498	57,270	53,200	57,660	4,460	8.4%
Instrumentation and Facilities	17,922	24,920	20,100	21,760	1,660	8.3%
Continental Dynamics	6,330	7,460	7,270	7,870	600	8.3%
Total	75,750	89,650	80,570	87,290	6,720	8.3%
OCEAN SCIENCES						
Ocean Sciences Research Support	91,787	112,570	99,990	113,980	13,990	14.0%
Oceanographic Centers and Facilities	51,706	56,760	50,260	53,950	3,690	7.3%
Ocean Drilling Program	35,861	40,450	38,680	40,000	1,320	3.4%
Total	179,354	209,780	188,930	207,930	19,000	10.1%
Total, GEO	$381,602	$448,530	$403,870	$443,090	$39,220	9.7%

LEVEL OF FUNDING BY PROGRAM (continued)

(Dollars in Thousands)

PROGRAM ELEMENT	FY 1993 ACTUAL	FY 1994 REQUEST	FY 1994 CURRENT PLAN	FY 1995 REQUEST	CHANGE FY 95 Req/FY 94 CP AMOUNT	PERCENT
MATHEMATICAL AND PHYSICAL SCIENCES						
MATHEMATICAL SCIENCES						
Disciplinary Research in Mathematics	$45,132	$51,910	$46,640	$49,000	$2,360	5.1%
Cross-Disciplinary & Computational Research in Mathematics	15,772	18,030	17,370	20,010	2,640	15.2%
Special Projects	16,715	18,070	18,200	19,700	1,500	8.2%
Total	77,619	88,010	82,210	88,710	6,500	7.9%
ASTRONOMICAL SCIENCES						
Astronomy Research Project Support	36,091	40,780	40,990	43,190	2,200	5.4%
National Astronomy & Ionosphere Center	9,687	9,070	8,600	9,000	400	4.7%
National Optical Astronomy Observatories	27,597	31,210	27,490	28,790	1,300	4.7%
National Radio Astronomy Observatory	29,811	32,880	29,340	30,940	1,600	5.5%
Total	103,186	113,940	106,420	111,920	5,500	5.2%
PHYSICS						
Physics Research Project Support	96,183	106,850	98,230	103,730	5,500	5.6%
Facilities	32,100	35,750	35,500	38,000	2,500	7.0%
Total	128,283	142,600	133,730	141,730	8,000	6.0%
CHEMISTRY						
Chemistry Research Project Support	95,531	111,500	102,900	109,430	6,530	6.3%
Instrumentation & Infrastructure	16,730	19,390	18,500	20,470	1,970	10.6%
Total	112,261	130,890	121,400	129,900	8,500	7.0%
MATERIALS RESEARCH						
Materials Research Project Support	80,539	92,410	88,400	95,270	6,870	7.8%
Materials Research Science and Engineering Centers	51,529	56,440	54,810	55,310	500	0.9%
National Facilities and Instrumentation	32,439	34,100	32,880	34,880	2,000	6.1%
Total	164,507	182,950	176,090	185,460	9,370	5.3%
Total, MPS	$585,856	$658,390	$619,850	$657,720	37,870	6.1%

LEVEL OF FUNDING BY PROGRAM (continued)

(Dollars in Thousands)

PROGRAM ELEMENT	FY 1993 ACTUAL	FY 1994 REQUEST	FY 1994 CURRENT PLAN	FY 1995 REQUEST	CHANGE FY 95 Req/FY 94 CP AMOUNT	PERCENT
SOCIAL, BEHAVIORAL AND ECONOMIC SCIENCES						
SOCIAL, BEHAVIORAL AND ECONOMIC RESEARCH						
Economic, Decision & Management Sciences	$20,045	$23,720	$20,490	$25,000	$4,510	22.0%
Social and Political Sciences	15,801	17,340	16,515	20,000	3,485	21.1%
Anthropological & Geographic Sciences	12,924	14,730	12,705	14,800	2,095	16.5%
Cognitive, Psychological & Language Sciences	13,058	14,660	12,320	14,170	1,850	15.0%
Science, Technology and Society	3,816	4,860	8,580	10,000	1,420	16.6%
Total	65,644	75,310	70,610	83,970	13,360	18.9%
INTERNATIONAL COOPERATIVE SCIENTIFIC ACTIVTIES						
International Coopertive Scientific Activities	13,247	18,920	15,710	16,710	1,000	6.4%
Total	13,247	18,920	15,710	16,710	1,000	6.4%
SCIENCE RESOURCES STUDIES						
Studies of Science and Engineering Resources	11,778	12,680	11,930	11,930	0	0.0%
Total	11,778	12,680	11,930	11,930	0	0.0%
Total, SBE	**$90,669**	**$106,910**	**$98,250**	**$112,610**	**$14,360**	**14.6%**

LEVEL OF FUNDING BY PROGRAM (continued)

(Dollars in Thousands)

PROGRAM ELEMENT	FY 1993 ACTUAL	FY 1994 REQUEST	FY 1994 CURRENT PLAN	FY 1995 REQUEST	CHANGE FY 95 Req/FY 94 CP	
					AMOUNT	PERCENT
UNITED STATES POLAR RESEARCH PROGRAMS	$180,777	$163,100	$158,100	$162,830	$4,730	3.0%
UNITED STATES ANTARCTIC LOGISTICAL SUPPORT ACTIVITIES	$63,429	$65,100	$62,600	$62,600	$0	0.0%
CRITICAL TECHNOLOGIES INSTITUTE	$1,000	$1,000	$1,500	$2,000	$500	33.3%
MAJOR RESEARCH EQUIPMENT /3	[$34,070]	[$60,000]	[$52,000]	$0	[($52,000)]	[-100%]
Subtotal, RESEARCH AND RELATED ACTIVITIES /1	$2,046,314	$2,374,000	$2,168,700	$2,348,700	180,000	8.3%
Carryover		0	5,527	0	(5,527)	-100.0%
Total, RESEARCH AND RELATED ACTIVITIES	$2,046,314	$2,374,000	$2,174,227	$2,348,700	$174,473	8.0%

LEVEL OF FUNDING BY PROGRAM (continued)

(Dollars in Thousands)

PROGRAM ELEMENT	FY 1993 ACTUAL	FY 1994 REQUEST	FY 1994 CURRENT PLAN	FY 1995 REQUEST	CHANGE FY 95 Req/FY 94 CP AMOUNT	CHANGE FY 95 Req/FY 94 CP PERCENT
EDUCATION AND HUMAN RESOURCES						
SYSTEMIC REFORM						
Educational System Reform	$57,640	$78,560	$78,060	$86,060	$8,000	10.2%
Experimental Program to Stimulate Competitive Research (EPSCoR)	24,647	24,420	31,920	31,920	0	0.0%
Total	82,287	102,980	109,980	117,980	8,000	7.3%
ELEMENTARY, SECONDARY AND INFORMAL EDUCATION						
Student Support	11,305	11,000	11,000	11,000	0	0.0%
Curriculum Development	40,182	45,450	44,120	45,120	1,000	2.3%
Teacher Enhancement & Development	98,586	106,500	108,160	108,160	0	0.0%
Informal Science Education	34,611	35,000	35,000	35,000	0	0.0%
Total	184,684	197,950	198,280	199,280	1,000	0.5%
UNDERGRADUATE EDUCATION						
Curriculum & Laboratory Development	41,558	48,430	55,010	57,010	2,000	3.6%
Teacher and Faculty Development	20,349	26,410	26,000	26,000	0	0.0%
Total	61,907	74,840	81,010	83,010	2,000	2.5%
GRADUATE EDUCATION AND RESEARCH DEVELOPMENT						
Graduate Student Support	77,373	58,790	58,790	63,390	4,600	7.8%
Faculty Development	8,043	7,670	7,670	7,670	0	0.0%
Total	85,416	66,460	66,460	71,060	4,600	6.9%
HUMAN RESOURCE DEVELOPMENT						
Precollege Education	14,876	13,830	14,830	14,830	0	0.0%
Undergraduate Student Support	19,167	26,010	25,510	25,510	0	0.0%
Institutional Support	12,592	15,450	15,450	15,450	0	0.0%
Model and Experimental Programs	2,978	10,600	10,600	10,600	0	0.0%
Total	49,613	65,890	66,390	66,390	0	0.0%
RESEARCH, EVALUATION AND DISSEMINATION						
Research	15,650	14,790	14,390	13,440	(950)	-6.6%
Evaluation	5,637	8,970	8,970	10,270	1,300	14.5%
Dissemination & Technology Utilization	19,869	24,220	24,120	24,570	450	1.9%
Total	41,156	47,980	47,480	48,280	800	1.7%
Subtotal, EHR Appropriation	505,063	556,100	569,600	586,000	16,400	2.9%
Carryover			7,077		(7,077)	
Total, EHR	$505,063	$556,100	$576,677	$586,000	$9,323	1.6%

LEVEL OF FUNDING BY PROGRAM (continued)

(Dollars in Thousands)

PROGRAM ELEMENT	FY 1993 ACTUAL	FY 1994 REQUEST	FY 1994 CURRENT PLAN	FY 1995 REQUEST	CHANGE FY 95 Req/FY 94 CP AMOUNT	PERCENT
ACADEMIC RESEARCH INFRASTRUCTURE	$49,754	$55,000	$100,000 /2	$55,000	($45,000)	-45.0%
Carryover	0	0	620	0	-620	-100.0%
Total	$49,754	$55,000	$100,620	$55,000	($45,620)	-45.3%
MAJOR RESEARCH EQUIPMENT /3	$34,070	$60,000	$52,000	$70,000	$18,000	34.6%
SALARIES AND EXPENSES	$110,838	$125,800	$118,300	$130,720	$12,420	10.5%
NSF HEADQUARTERS RELOCATION	$0	$5,200	$5,200	$5,200	$0	0.0%
OFFICE OF INSPECTOR GENERAL	$3,687	$4,100	$3,997	$4,380	$383	9.5%
Subtotal, NATIONAL SCIENCE FOUNDATION	$2,749,726	$3,180,200	$3,017,797	$3,200,000	$182,203	6.0%
Carryover	0	0	13,224	0	($13,224)	-100.0%
TOTAL, NATIONAL SCIENCE FOUNDATION	$2,749,726	$3,180,200	$3,031,021	$3,200,000	$168,979	5.6%

1/ Displays proposed merger of Research and Related Activities, U.S. Polar Research Programs, U.S. Antarctic Logistics, and Critical Technologies Institute appropriations into the Research and Related Activities appropriation.

2/ FY 1994 Current Plan for Academic Research Infrastructure amount excludes $10 million as proposed for rescission.

3/ Major Research Equipment (MRE) appropriation is proposed in FY 1995 to fund the construction of major research equipment currently funded through the Research and Related Activities appropriation. For comparability, the FY 1993 and FY 1994 amounts for these construction projects are shown in MRE.

EXPLANATION OF CARRYOVER 1993

The National Science Foundation's total unobligated balance of $13.224 million from the FY 1993 Appropriation consist of the amounts displayed in the table below. All remaining balances will be obligated in FY 1994 to support activities for which these funds were intended in FY 1993.

- $7.077 million from the FY 1993 Education and Human Resources Activities Appropriation. These funds will be obligated in FY 1994 as follows: $3.0 million for the Systemic Reform Subactivity to fund Urban Systemic Initiative awards; $2.6 million for the Elementary, Secondary, and Informal Education Subactivity to fund Presidential Awards for Excellence in Science and Mathematics Teaching and $1.0 million for funding of the National Science Teachers Association (NSTA) contract.

- $5.527 million from the FY 1993 Research and Related Activities Appropriation. Of this total, $5 million will be obligated in FY 1994 by the Design, Manufacture, and Industrial Innovation Subactivity in the Engineering activity to fund the Agile Manufacturing Initiative (AMI), which was deferred for funding until FY 1994.

Crosswalk from Current Plan to FY 1994 Estimates
(Dollars in Thousands)

	FY 1994 Current Plan New Obligation Authority	FY 1994 Carryover from FY 1993	FY 1994 Estimate
Biological Sciences	287,780	26	287,806
Computer and Information Science and Engineering	240,580	26	240,606
Engineering	289,170	5,000	294,170
Geosciences	403,870	26	403,896
Mathematical and Physical Sciences	615,850	26	615,876
Social, Behavioral and Economic Sciences	98,250	25	98,275
U.S. Polar Research Programs	158,100	398	158,498
U.S. Antarctic Logistical Support Activities	62,600	0	62,600
Critical Technologies Institute	1,500	0	1,500
Major Research Equipment	63,000	0	63,000
Subtotal, Research and Related Activities	$2,220,700	$5,527	$2,226,227
Education and Human Resources	569,600	7,077	576,677
Academic Research Infrastructure	100,000	620	100,620
Salaries and Expenses	118,300	0	118,300
NSF Headquarters Relocation	5,200	0	5,200
Office of Inspector General	3,997	0	3,997
Total, NSF	$3,017,797	$13,224	$3,031,021

CHANGES BETWEEN FY 1994 REQUEST AND FY 1994 CURRENT PLAN

The FY 1994 Current Plan for the National Science Foundation is $3,017.79 million, $162.41 million, or 5.1 percent less than originally requested. This represents an increase of $266.86 million or 9.7 percent above the FY 1993 level.

(Millions of Dollars)

Appropriation	FY 1993 Actual	FY 1994 Request	FY 1994 Current Plan	Change Plan/Request Amount	Change Plan/Request Percent
Research and Related Activities	2,080.38	2,434.00	2,220.70 [1]	-213.30	-8.8%
Education and Human Resources	505.06	556.10	569.60	13.50	2.4%
Academic Research Infrastructure	49.75	55.00	100.00 [2]	45.00	81.8%
Salaries and Expenses	110.84	125.80	118.30	-7.50	-6.0%
NSF Headquarters Relocation	0.00	5.20	5.20	0.00	N/A
Office of Inspector General	3.69	4.10	4.00	-0.10	-2.4%
Total, NSF	$2,749.72	$3,180.20	$3,017.80	-162.40	-5.1%

1/ To provide consistency in the President's FY 1995 Budget Request, the presentation and discussion of the Research and Related Activities account includes activities for the U.S. Polar Programs Activities and the Critical Technologies Institute, which are proposed to be included within this appropriation beginning in FY 1995. For detail see table below.
2/ Assumes proposed $10 million rescission to which the Administration has not objected.

Old Structure: FY 1994	FY 1993 Actual	FY 1994 Request	FY 1994 Current Plan
Research and Related Activities Account	1,835,174	2,204,800	1,998,500
[Major Research Equipment Subactivity]	[48,080]	[72,000]	[64,000]
U.S. Polar Research Programs	180,777	163,100	158,100
U.S. Antarctic Logistical Support Activities	63,429	65,100	62,600
Critical Technologies Institute	1,000	1,000	1,500
Total, R&RA New Structure (FY 1995 Proposed)	$2,080,380	$2,434,000	$2,220,700

The tables interspersed throughout this narrative provide the specific allocations of resources to the various activities and subactivities and highlight a number of specific programmatic and budgetary proposals contained within the FY 1994 current plan.

CURRENT PLAN BY APPROPRIATION ACCOUNT

Each Appropriation and major Activity is discussed separately below.

RESEARCH AND RELATED ACTIVITIES

The FY 1994 Current Plan for the Research and Related Activities account is $2,220.70 million, $213.30 million, or 8.8 percent less than originally requested, due to Congressionally-mandated reductions.

Within the FY 1994 current plan, support for individual investigators and small group activities is $1.28 billion, a $144 million (10.1 percent) reduction from the FY 1994 Request, resulting in fewer research awards across nearly all disciplinary and interagency initiatives. NSF continues to place a high priority on support for individual investigator and small group activities which will increase slightly more than 9.8 percent over the comparable level for FY 1993. The basic research conducted by individuals and small groups covers all disciplines in science and engineering -- including the strategically important areas outlined elsewhere in this current plan.

Research centers will be funded at a total level of $176 million, consistent with the FY 1994 Request. Within this allocation, the Engineering Activity plans to establish up to four new Engineering Research Centers focused on technologies associated with manufacturing, materials processing, and high performance computing and communications (bringing the total number of ERC's to 21 or 22); the Mathematical and Physical Sciences Activity will support the establishment of one or two new Materials Research Science and Engineering Centers; and the Biological Sciences Activity will move forward to establish a Center for Ecological Analysis and Synthesis.

Support for major research facilities -- including the national astronomy centers, the national supercomputer centers and the NSFNET, the National Center for Atmospheric Research, the academic fleet, and Antarctic operations and logistics, as well as smaller user facilities -- will be $579 million, $58 million, or 9.1 percent, less than the FY 1994 Budget Request of $637 million. Within this amount, the Laser Interferometer Gravitational Wave Observatory (LIGO) is to be funded at a level of $35 million, $8 million less than the Request, as specified by the conferees. This amount will ensure continued development and progress toward the completion of this project. For the GEMINI 8-Meter telescope, which has all the international cost sharing requirements in place, $17 million will be allocated, which was requested; this funding level will sustain the current project schedule. The National High Magnetic Field Laboratory, with strong support from the State of Florida, will also be funded at the requested level of $12 million.

Consistent with the direction provided by the conferees, further action on the acquisition of an Arctic research vessel has been deferred pending the outcome of a GAO analysis of the various acquisition strategies that could be employed. All other facilities are being reduced to levels that sustain current levels of effort.

Many aspects of the Foundation's education and training activities are integrally tied to research efforts and are therefore supported within this account. Approximately $189 million, a $6 million, or 2.9 percent, reduction from the request, for these activities results in fewer awards. This increase over FY 1993 will support a variety of activities including undergraduate research experiences, engineering education coalitions, and special graduate and postdoctoral opportunities.

For NSF as a whole, consistent with the Small Business Research Innovation Act, a total of $33.8 million will be allocated for the Small Business Innovation Research program and $1.2 million for the Small Business Technology Transfer (STTR) pilot program. The STTR program is a new government-wide effort designed to improve collaboration between small businesses and university researchers. Both are legislatively mandated, at 1.5 percent and 0.05 percent of extramural research, respectively.

FY 1994 CURRENT PLAN

RESEARCH AND RELATED ACTIVITIES APPROPRIATION

BIOLOGICAL SCIENCES ACTIVITY

The FY 1994 Current Plan for the Biological Sciences (BIO) Activity is $288.78 million, $23.13 million or 7.4 percent less than the FY 1994 Budget Request of $311.91 million, due to Congressionally-mandated reductions.

All Subactivities were proportionally reduced except for the *Biological Instrumentation and Resources (BIR) Subactivity*, reflecting the priority given in the FY 1994 current plan to certain infrastructural activities centrally funded in BIR. This includes the following:

- infrastructural support for the *Arabidopsis* Genome Plant project;
- a new postdoctoral program in molecular evolution;
- the interagency plant science initiative; and
- the Research Training Groups (RTG) program.

Centralized management within the *BIR Subactivity* for these and other infrastructural programs provides for more efficient management and oversight, and enhanced coordination and representation across all the biological sciences. BIR's mission is to centrally manage and coordinate infrastructural activities in the biological sciences.

Within the *Environmental Biology Subactivity*, the Systematics and Population Biology program element was favored due to the emphasis being placed on biodiversity in the environmental research initiative.

FY 1994 CURRENT PLAN - LEVEL OF FUNDING BY PROGRAM

(Dollars in Thousands)

PROGRAM ELEMENT	FY 1993 ACTUAL	FY 1994 REQUEST	FY 1994 CURRENT PLAN	DIFFERENCE PLAN/REQUEST AMOUNT	DIFFERENCE PLAN/REQUEST PERCENT
BIOLOGICAL SCIENCES					
MOLECULAR AND CELLULAR BIOSCIENCES					
Biochemistry and Molecular Structure and Function	$32,728	$37,100	$33,850	($3,250)	-8.8%
Cell Biology	$19,284	$21,750	$19,890	($1,860)	-8.6%
Genetics and Nucleic Acids	$29,126	$34,460	$31,350	($3,110)	-9.0%
Total	$81,138	$93,310	$85,090	($8,220)	-8.8%
INTEGRATIVE BIOLOGY AND NEUROSCIENCES					
Physiology and Behavior	$28,648	$33,510	$30,520	($2,990)	-8.9%
Neuroscience	$30,808	$34,690	$31,310	($3,380)	-9.7%
Developmental Mechanisms	$14,822	$17,780	$16,040	($1,740)	-9.8%
Total	$74,278	$85,980	$77,870	($8,110)	-9.4%
ENVIRONMENTAL BIOLOGY					
Systematics and Population Biology	$22,059	$25,400	$23,740	($1,660)	-6.5%
Ecological Studies	$23,800	$28,820	$26,160	($2,660)	-9.2%
Long-term Projects in Environmental Biology	$24,305	$27,170	$24,900	($2,270)	-8.4%
Total	$70,164	$81,390	$74,800	($6,590)	-8.1%
BIOLOGICAL INSTRUMENTATION AND RESOURCES					
Instrumentation and Instrument Development	$13,586	$14,850	$14,790	($60)	-0.4%
Special Projects	$32,158	$36,380	$36,230	($150)	-0.4%
Total	$45,744	$51,230	$51,020	($210)	-0.4%
Total, BIO	$271,324	$311,910	$288,780	($23,130)	-7.4%

FY 1994 CURRENT PLAN

RESEARCH AND RELATED ACTIVITIES APPROPRIATION

COMPUTER AND INFORMATION SCIENCE AND ENGINEERING ACTIVITY

The FY 1994 Current Plan for the Computer and Information Science and Engineering (CISE) Activity is $240.58 million, $55.43 million or 18.7 percent less than the FY 1994 Budget Request of $296.01 million due to Congressionally-mandated reductions.

Reductions were not taken proportionally across the Subactivities reflecting the emphasis on the High Performance Computing and Communications (HPCC) program. To the extent possible, this priority has been maintained in the FY 1994 current plan. However, the reduction from the request necessitated a readjustment within the CISE Activity to reflect the priorities assigned to the various components of the HPCC initiative as follows:

- The highest priority was afforded the *Networking and Communications Research and Infrastructure Subactivity,* which decreases by only 6.3 percent or $3.48 million from the FY 1994 Request, because of its importance to disciplinary research and education, the demands resulting from a transition to a new architecture and its interagency importance in the HPCC and Information Infrastructure Technology and Applications (IITA) program. The Networking and Communications Research program element decreases 12.4 percent and will support fewer awards in new gigabit testbed research.

- The next highest priority was afforded the *Advanced Scientific Computing Subactivity* (18.0 percent reduction) and the *Computer and Computation Research Subactivity* (18.3 percent reduction):

  - The Centers program will sustain the four NSF supercomputer centers at levels sufficient to maintain ongoing activities, but plans to strengthen access to emerging scalable parallel architectures will be curtailed and the plan to create Regional Affiliates will be initiated but at a reduced level. Fewer awards will be made in the New Technologies program.

  - The *Computer and Computation Research Subactivity* will support fewer Grand Challenge applications and make less awards in theory and experimentation in computer controlled manufacturing technologies.

- Lower priority was assigned to the following Subactivities which were proportionally reduced accordingly:

  - The *Cross-Disciplinary Activities Subactivity* (a 24.1 percent reduction from the Request) will defer acquisition of small-scale new architecture computers and infrastructure needed for Grand Challenge Applications.

  - The *Information, Robotics and Intelligent Systems Subactivity*, which decreases 26.6 percent from the Request, will not support as many awards for research in massively parallel algorithms and other new computational models for intelligent systems; support for the Advanced Manufacturing Technology program will be deferred.

  - The *Microelectronic Information Processing Systems Subactivity*, which decreases 27.6 percent from the Request, will reduce support for the Advanced Manufacturing Technology program, but sustain efforts in the HPCC initiative.

FY 1994 CURRENT PLAN - LEVEL OF FUNDING BY PROGRAM (continued)

(Dollars in Thousands)

PROGRAM ELEMENT	FY 1993 ACTUAL	FY 1994 REQUEST	FY 1994 CURRENT PLAN	DIFFERENCE PLAN/REQUEST AMOUNT	PERCENT
COMPUTER AND INFORMATION SCIENCE AND ENGINEERING					
COMPUTER AND COMPUTATION RESEARCH					
Theory of Computing	$8,541	$10,040	$9,085	($955)	-9.5%
Numberic, Symbolic and Geometric Computation	$6,071	$9,200	$7,010	($2,190)	-23.8%
Computer Systems	$3,880	$5,320	$4,125	($1,195)	-22.5%
System Software	$11,962	$15,350	$12,680	($2,670)	-17.4%
Software Engineering	$4,326	$6,160	$4,760	($1,400)	-22.7%
Total	$34,780	$46,070	$37,660	($8,410)	-18.3%
INFORMATION, ROBOTICS AND INTELLIGENT SYSTEMS					
Knowledge and Database System	$11,888	$18,210	$13,130	($5,080)	-27.9%
Robotics and Machine Intelligence	$6,291	$9,150	$7,100	($2,050)	-22.4%
Interactive Systems	$4,674	$6,860	$4,800	($2,060)	-30.0%
Information Technology and Organizations	$4,127	$6,400	$4,800	($1,600)	-25.0%
Total	$26,980	$40,620	$29,830	($10,790)	-26.6%
MICROELECTRONIC INFORMATION PROCESSING SYSTEMS					
Design, Tools and Test	$4,161	$5,840	$4,440	($1,400)	-24.0%
Microeletronic Systems Architecture	$3,871	$5,480	$4,175	($1,305)	-23.8%
Circuits and Signal Processing	$4,176	$5,780	$4,445	($1,335)	-23.1%
Experimental Systems	$7,074	$10,610	$7,820	($2,790)	-26.3%
Systems Prototyping and Fabrication	$2,303	$5,120	$2,900	($2,220)	-43.4%
Total	$21,585	$32,830	$23,780	($9,050)	-27.6%
ADVANCED SCIENTIFIC COMPUTING					
Centers	$65,916	$80,370	$69,860	($10,510)	-13.1%
New Technologies	$4,098	$10,900	$5,000	($5,900)	-54.1%
Total	$70,014	$91,270	$74,860	($16,410)	-18.0%
NETWORKING AND COMMUNICATIONS RESEARCH AND INFRASTRUCTURE					
NSFNET	$30,107	$43,190	$41,163	($2,027)	-4.7%
Networking and Communications Research	$9,796	$11,750	$10,297	($1,453)	-12.4%
Total	$39,903	$54,940	$51,460	($3,480)	-6.3%
CROSS-DISCIPLINARY ACTIVITIES					
CISE Institutional Infrastructure	$18,835	$25,740	$19,430	($6,310)	-24.5%
CISE Instrumentation	$3,506	$4,540	$3,560	($980)	-21.6%
Total	$22,341	$30,280	$22,990	($7,290)	-24.1%
Total, CISE	$215,603	$296,010	$240,580	($55,430)	-18.7%

FY 1994 CURRENT PLAN

RESEARCH AND RELATED ACTIVITIES APPROPRIATION

ENGINEERING ACTIVITY

The FY 1994 Current Plan for the Engineering (ENG) Activity is $295.17 million, $27.88 million or 8.6 percent less than the FY 1994 Budget Request of $323.05 million due to Congressionally-mandated reductions.

Reductions were not taken proportionally across the Subactivities due to the high priority given to the ENG Activity with a requested increase of 23.7 percent. This reflected the Administration's emphasis on the Advanced Manufacturing Technology (AMT) program. To the extent possible, this priority has been maintained in the FY 1994 current plan, at the direction of the conferees. However, the reduction from the request necessitated a readjustment within the ENG Activity to reflect a higher level of research on manufacturing as follows:

Highest priority was afforded the following two Subactivities to meet engineering education needs and reflect an emphasis on manufacturing research:

- The *Design, Manufacture, and Industrial Innovation Subactivity* decreases only 4.4 percent from the Request, to support manufacturing design studies and industrial liaison. The Manufacturing Processes and Equipment program will support fewer awards. The Industry/University Liaison program increases significantly over the FY 1994 Request due to the initiation of the new Small Business Technology Transfer (STTR) program, which had not been requested. The Small Business Innovation Research program will also meet legislatively-mandated requirements.

- The *Engineering Education and Centers Subactivity* decreases only 4.3 percent from the Request to support additional Engineering Research Centers and Industry/University Cooperative Research Centers focused on technologies associated with manufacturing. Higher priority was assigned to the Engineering Research Centers program to increase emphasis on manufacturing research, and to the Engineering Education program to improve engineering education of the next generation of engineers through the Coalitions program. Fewer awards will be made across the Subactivity than had been planned in the Request.

Lower priority was given to the remaining Subactivities which were proportionally reduced. Fewer research awards will be made although emphasis will be given to research on manufacturing. For example, the *Bioengineering and Environmental Systems Subactivity* will support bioprocessing research. The *Chemical and Transport Systems Subactivity* and the *Electrical and Communications Systems Subactivity* will both support research in the area of environmentally conscious manufacturing. The Emerging Technologies Initiation program element in the ECS Subactivity is being terminated to consolidate current efforts. Research in microelectromechanical systems will be supported in the Solid State and Microstructures program and research on surface phenomena will be supported in the CTS Subactivity.

The changes noted in the following table reduce the number of ENG Subactivities by one and achieve greater organizational efficiency.

	New Structure						
	Bioengineering & Environmental Systems	Civil & Mechanical Systems	Chemical & Transport Systems	Design, Manufacture & Industrial Innovation	Engineering Education & Centers	Electrical & Communication Systems	94 Old Total
Old Structure							
Biological and Critical Systems	22.13	17.61					$39.74
Chemical & Thermal Systems			37.07				$37.07
Design & Manufacturing Systems				29.70			$29.70
Electrical & Communication Systems						36.97	$36.97
Engineering Education & Centers					88.68		$88.68
Industrial Innovation interface				36.90			$36.90
Mechanical & Structural Systems		26.11					$26.11
94 New Total	$22.13	$43.72	$37.07	$66.60	$88.68	$36.97	$295.17

FY 1994 CURRENT PLAN - LEVEL OF FUNDING BY PROGRAM (continued)

(Dollars in Thousands)

PROGRAM ELEMENT	FY 1993 ACTUAL	FY 1994 REQUEST	FY 1994 CURRENT PLAN	DIFFERENCE PLAN/REQUEST AMOUNT	PERCENT
ENGINEERING					
BIOENGINEERING AND ENVIRONMENTAL SYSTEMS					
Bioengineering	$14,582	$18,154	$16,000	($2,154)	-11.9%
Environmental and Ocean Systems	$5,839	$6,590	$6,130	($460)	-7.0%
Total	$20,421	$24,744	$22,130	($2,614)	-10.6%
CHEMICAL AND TRANSPORT SYSTEMS					
Chemical Reaction Processes	$9,302	$11,393	$9,900	($1,493)	-13.1%
Interfacial, Transport and Separations Processes	$8,622	$10,254	$9,220	($1,034)	-10.1%
Fluid, Particulate and Hydraulic Systems	$9,187	$10,782	$9,900	($882)	-8.2%
Thermal Systems	$7,360	$9,841	$8,050	($1,791)	-18.2%
Total	$34,471	$42,270	$37,070	($5,200)	-12.3%
DESIGN, MANUFACTURE, AND INDUSTRIAL INNOVATION					
Operations Research and Production Systems	$5,730	$8,345	$7,680	($665)	-8.0%
Design and Integration Engineering	$5,373	$8,295	$7,560	($735)	-8.9%
Manufacturing Processes and Equipment	$10,436	$16,160	$14,460	($1,700)	-10.5%
Small Business Innovation Research	$23,008	$33,120	$31,200	($1,920)	-5.8%
Management of Technological Innovation	$503	$1,300	$1,500	$200	15.4%
Special Studies and Assessments	$1,153	$1,470	$1,400	($70)	-4.8%
Industry/University Liaison	$0	$1,000	$2,800	$1,800	180.0%
Total	$46,203	$69,690	$66,600	($3,090)	-4.4%
ELECTRICAL AND COMMUNICATIONS SYSTEMS					
Quantum Electronics, Waves and Beams	$9,213	$11,714	$10,040	($1,674)	-14.3%
Solid State and Microstructures	$10,482	$12,764	$11,410	($1,354)	-10.6%
Communications and Computational Systems	$5,208	$6,837	$6,570	($267)	-3.9%
Engineering Systems	$8,067	$10,405	$8,950	($1,455)	-14.0%
Emerging Technologies Initiation	$1,149	$1,100	$0	($1,100)	-100.0%
Total	$34,119	$42,820	$36,970	($5,850)	-13.7%
ENGINEERING EDUCATION AND CENTERS					
Engineering Education	$15,402	$18,400	$18,300	($100)	-0.5%
Human Resources Development	$11,441	$12,610	$11,030	($1,580)	-12.5%
Engineering Research Centers	$47,500	$52,500	$51,500	($1,000)	-1.9%
Industry/University Cooperative Research Centers	$6,701	$9,200	$7,850	($1,350)	-14.7%
Total	$81,044	$92,710	$88,680	($4,030)	-4.3%
CIVIL AND MECHANICAL SYSTEMS					
Earthquake Hazard Mitigation	$13,611	$17,482	$15,000	($2,482)	-14.2%
Natural and Technological Hazard Mitigation	$2,584	$3,194	$2,610	($584)	-18.3%
Dynamic Systems and Control	$3,792	$4,867	$4,200	($667)	-13.7%
Structures, Geomechanics and Building Systems	$8,658	$10,954	$9,510	($1,444)	-13.2%
Surface Engineering and Tribology	$2,516	$3,366	$2,840	($526)	-15.6%
Mechanics and Materials	$8,635	$10,953	$9,560	($1,393)	-12.7%
Total	$39,796	$50,816	$43,720	($7,096)	-14.0%
Total, ENG	$256,054	$323,050	$295,170	($27,880)	-8.6%

FY 1994 CURRENT PLAN

RESEARCH AND RELATED ACTIVITIES APPROPRIATION

GEOSCIENCES ACTIVITY

The FY 1994 Current Plan for the Geosciences (GEO) Activity is $403.87 million, $44.66 million or 10.0 percent less than the FY 1994 Budget Request of $448.53 million due to Congressionally-mandated reductions. All Subactivities were proportionally reduced.

Synopses of major changes:

- In the *Earth Sciences Subactivity*, priority given to the U.S. Global Change Research Program and to Science and Technology Centers is reflected in the Continental Dynamics and Earth Sciences Project Support program elements.
- In the *Ocean Sciences Subactivity*, priority given to meeting commitments to the international partners is reflected in the Ocean Drilling Program.

FY 1994 CURRENT PLAN - LEVEL OF FUNDING BY PROGRAM (continued)

(Dollars in Thousands)

PROGRAM ELEMENT	FY 1993 ACTUAL	FY 1994 REQUEST	FY 1994 CURRENT PLAN	DIFFERENCE PLAN/REQUEST AMOUNT	PERCENT
GEOSCIENCES					
ATMOSPHERIC SCIENCES					
Atmospheric Sciences Project Support	$69,439	$81,930	$75,470	($6,460)	-7.9%
National Center for Atmospheric Research	$50,171	$59,240	$51,800	($7,440)	-12.6%
Upper Atmospheric Facilities	$6,888	$7,930	$7,100	($830)	-10.5%
Total	$126,498	$149,100	$134,370	($14,730)	-9.9%
EARTH SCIENCES					
Earth Sciences Project Support	$51,498	$57,270	$53,200	($4,070)	-7.1%
Instrumentation and Facilities	$17,922	$24,920	$20,100	($4,820)	-19.3%
Continental Dynamics	$6,330	$7,460	$7,270	($190)	-2.5%
Total	$75,750	$89,650	$80,570	($9,080)	-10.1%
OCEAN SCIENCES					
Ocean Sciences Research Support	$91,787	$112,570	$99,990	($12,580)	-11.2%
Oceanographic Centers and Facilities	$51,706	$56,760	$50,260	($6,500)	-11.5%
Ocean Drilling Program	$35,861	$40,450	$38,680	($1,770)	-4.4%
Total	$179,354	$209,780	$188,930	($20,850)	-9.9%
Total, GEO	$381,602	$448,530	$403,870	($44,660)	-10.0%

FY 1994 CURRENT PLAN

RESEARCH AND RELATED ACTIVITIES APPROPRIATION

MATHEMATICAL AND PHYSICAL SCIENCES ACTIVITY

The FY 1994 Current Plan for the Mathematical and Physical Sciences (MPS) Activity is $671.85 million, $46.54 million or 6.5 percent less than the FY 1994 Budget Request of $718.39 million due to Congressionally-mandated reductions.

In taking the Congressionally-mandated reductions, to the extent possible, priority was given to maintaining significant increments for the related advanced materials and processing, manufacturing and biotechnology initiatives, to the high performance computing and communications initiative, and to science, mathematics, engineering and technology education. In addition, priority was placed on contributing to Global Change Research initiative and on maintaining a forward-looking position in environmental research.

The emphasis on materials afforded the *Materials Research Subactivity* a higher priority resulting in only a 4.0 percent reduction from the Request and a 9.0 percent increase over FY 1993. One or two additional Materials Research Science and Engineering Center awards will be made, reflecting the importance of interdisciplinary research in this area of inquiry and the biennial competition for these centers currently in progress.

The emphasis on the environment afforded the *Chemistry Subactivity* a higher priority, resulting in an 8.1 percent increase over FY 1993. The reduction of 7.3 percent from the FY 1994 Request is larger than typical in the MPS Activity because the initiation of the emphasis on the environment planned within the FY 1993 Stimulus Package did not materialize.

In the *Major Research Equipment Subactivity*, which decreases by 11.1 percent from the Request, highest priority was given to sustaining the project schedule for the National High Magnetic Field Laboratory (NHMFL) and to meeting international commitments for the GEMINI 8-meter telescope project, both of which are funded at the Request level. The reduction ($8 million) to the Laser Interferometer Gravitational Wave Observatory (LIGO), funded at $35 million, was directed by the conferees.

The *Mathematical Sciences*, *Astronomical Sciences*, and *Physics Subactivities* were proportionally reduced. Fewer research awards will be made than had been planned for within the Request. In the Physics Facilities program, the upgrade to the Cornell Electron Storage Ring (CESR) will be initiated.

Note: In the FY 1995 Budget Request the National High Magnetic Field Laboratory will be included in the National Facilities and Instrumentation program element in the *Materials Research Subactivity* of the Mathematical and Physical Sciences Activity, as this project is well underway and is beginning operations.

Also, within the FY 1995 Budget Request, the LIGO and GEMINI construction projects are proposed to be assigned to a new account: Major Research Equipment. This new account enhances management and oversight of construction projects of this magnitude.

(Millions of Dollars)

Project	FY 1993 Actual	FY 1994 Request	FY 1994 C.P.
National High Magnetic Field Laboratory	14.01	12.00	12.00
Laser Interferometer Gravitational Wave Observatory	20.00	43.00	35.00
GEMINI 8-meter Telescope	14.07	17.00	17.00
Total	48.08	72.00	64.00

FY 1994 CURRENT PLAN - LEVEL OF FUNDING BY PROGRAM (continued)

(Dollars in Thousands)

PROGRAM ELEMENT	FY 1993 ACTUAL	FY 1994 REQUEST	FY 1994 CURRENT PLAN	DIFFERENCE PLAN/REQUEST AMOUNT	DIFFERENCE PLAN/REQUEST PERCENT
MATHEMATICAL AND PHYSICAL SCIENCES					
MATHEMATICAL SCIENCES					
Disciplinary Research in Mathematics	$45,132	$51,910	$46,640	($5,270)	-10.2%
Cross-Disciplinary and Computational Research in Mathematics	$15,772	$18,030	$17,370	($660)	-3.7%
Special Projects	$16,715	$18,070	$18,200	$130	0.7%
Total	$77,619	$88,010	$82,210	($5,800)	-6.6%
ASTRONOMICAL SCIENCES					
Astronomy Research Project Support	$36,091	$40,780	$40,990	$210	0.5%
National Astronomy and Ionosphere Center	$9,687	$9,070	$8,600	($470)	-5.2%
National Optical Astronomy Observatories	$27,597	$31,210	$27,490	($3,720)	-11.9%
National Radio Astronomy Observatory	$29,811	$32,880	$29,340	($3,540)	-10.8%
Total	$103,186	$113,940	$106,420	($7,520)	-6.6%
PHYSICS					
Physics Research Project Support	$96,183	$106,850	$98,230	($8,620)	-8.1%
Facilities	$32,100	$35,750	$35,500	($250)	-0.7%
Total	$128,283	$142,600	$133,730	($8,870)	-6.2%
CHEMISTRY					
Chemistry Research Project Support	$95,531	$111,500	$102,900	($8,600)	-7.7%
Instrumentation and Infrastructure	$16,730	$19,390	$18,500	($890)	-4.6%
Total	$112,261	$130,890	$121,400	($9,490)	-7.3%
MATERIALS RESEARCH					
Materials Research Project Support	$80,539	$92,410	$88,400	($4,010)	-4.3%
Materials Research Science and Engineering Centers	$51,529	$56,440	$54,810	($1,630)	-2.9%
National Facilities and Instrumentation	$18,429	$22,100	$20,880	($1,220)	-5.5%
Total	$150,497	$170,950	$164,090	($6,860)	-4.0%
MAJOR RESEARCH EQUIPMENT					
Total	$48,080	$72,000	$64,000	($8,000)	-11.1%
Total, MPS	$619,926	$718,390	$671,850	($46,540)	-6.5%

FY 1994 CURRENT PLAN

RESEARCH AND RELATED ACTIVITIES APPROPRIATION

SOCIAL, BEHAVIORAL AND ECONOMIC SCIENCES ACTIVITY

The FY 1994 Current Plan for the Social, Behavioral and Economic Sciences (SBE) Activity is $98.25 million, $8.66 million or 8.1 percent less than the FY 1994 Budget Request of $106.91 million due to Congressionally-mandated reductions. Synopses of major changes follow:

- The *Social, Behavioral and Economic Sciences Subactivity* decreases 6.2 percent from the Request. Efforts to increase award size across all programs to sustain levels of excellence in research in education must be delayed. Interdisciplinary research and training in Intelligent Systems, focused on human capacities to receive, process, store and communicate information (especially at human/machine interfaces vital to advanced technologies for production and information management) must be delayed. The Science, Technology and Society program element increases 75 percent over the FY 1994 budget request in order to accommodate the following two important changes:
    - The Ethics and Values Studies (EVS) program, which previously had been distributed throughout the Foundation, is being centralized for management efficiency ($1.4 million); and
    - Cross-disciplinary activities ($3.0 million), previously funded across the program elements in the Subactivity, are being consolidated in order to provide more efficient management and oversight.

	New Structure					
Old Structure	Anthropology and Geographic Sciences	Cognitive, Psychological and Language Sciences	Economic, Decision and Management Sciences	Science, Technology and Society	Social and Political Sciences	FY 1994 Total, Old Structure
Economic, Decision and Management Sciences			20,490,000	750,000		$21,240,000
Social and Political Sciences				750,000	16,515,000	$17,265,000
Anthropology and Geographic Sciences	12,705,000			750,000		$13,455,000
Cognitive, Psychological and Language Sciences		12,320,000		750,000		$13,070,000
Science, Technology and Society				5,580,000		$5,580,000
FY 1994 Total, New Structure	$12,705,000	$12,320,000	$20,490,000	$8,580,000	$16,515,000	$70,610,000

The *International Cooperative Scientific Activities Subactivity* is reduced 17 percent from the Request resulting in continuation of ongoing programs with some delays in expansions and new programs.

The *Science Resources Studies Subactivity* is reduced 5.9 percent from the Request which will delay a new data collection effort on industrial innovation. It will also delay additional analyses of U.S. Scientific and Technical Personnel, and analyses for the *Science and Engineering Indicators* report.

FY 1994 CURRENT PLAN - LEVEL OF FUNDING BY PROGRAM (continued)

(Dollars in Thousands)

PROGRAM ELEMENT	FY 1993 ACTUAL	FY 1994 REQUEST	FY 1994 CURRENT PLAN	DIFFERENCE PLAN/REQUEST AMOUNT	PERCENT
SOCIAL, BEHAVIORAL AND ECONOMIC SCIENCES					
SOCIAL, BEHAVIORAL AND ECONOMIC RESEARCH					
Economic, Decision and Management Sciences	$20,045	$23,720	$20,490	($3,230)	-13.6%
Social and Political Sciences	$15,801	$17,340	$16,515	($825)	-4.8%
Anthropological and Geographic Sciences	$12,924	$14,730	$12,705	($2,025)	-13.7%
Cognitive, Psychological and Language Sciences	$13,058	$14,660	$12,320	($2,340)	-16.0%
Science, Technology and Society	$3,816	$4,860	$8,580	$3,720	76.5%
Total	$65,644	$75,310	$70,610	($4,700)	-6.2%
INTERNATIONAL COOPERATIVE SCIENTIFIC ACTIVITIES					
International Coopertive Scientific Activities	$13,247	$18,920	$15,710	($3,210)	-17.0%
Total	$13,247	$18,920	$15,710	($3,210)	-17.0%
SCIENCE RESOURCES STUDIES					
Studies of Science and Engineering Resources	$11,778	$12,680	$11,930	($750)	-5.9%
Total	$11,778	$12,680	$11,930	($750)	-5.9%
Total, SBE	$90,669	$106,910	$98,250	($8,660)	-8.1%

FY 1994 CURRENT PLAN

RESEARCH AND RELATED ACTIVITIES APPROPRIATION

U.S. POLAR PROGRAMS

The Foundation's Polar Program activities will be funded at a total level of $220.7 million, which includes $158.1 million for the U.S. Polar Research Programs (arctic and antarctic research activities) and $62.6 million for the U.S. Antarctic Logistical Support Activities (antarctic logistics and environmental, safety, and health activities).

The U.S. Polar Research Programs decreases $5.0 million, or 3 percent, from the Request of $163.1 million, due to Congressionally-mandated reductions. Changes from the Request are proportionally distributed as follows:

- The U.S. Arctic Research Program decreases by $1.0 million.
- The U.S. Antarctic Program decreases by $4.0 million. Reductions are in facilities improvement and operations areas.

The U.S. Antarctic Logistical Support Activities decreases $2.5 million from the Request of $65.1 million. The Safety, Environment and Health initiative will be protected; the reduction is reflected in decreases in contracts and procurement.

Note: It is proposed in the FY 1995 Budget Request to include this set of activities in the Research and Related Activities account, the detail is presented here in order to be consistent with the President's Budget Request for the Research and Related Activities account in FY 1995.

CRITICAL TECHNOLOGIES INSTITUTE

The Critical Technologies Institute (CTI) is a federally funded R&D center that provides analytical support to the Office of Science and Technology Policy (OSTP). Within the $1.5 million appropriated for CTI, and consistent with the conference report, $250,000 will be allocated for activities focused on the development of performance goals for federal investments in science and technology and $250,000 will be used to support a study by the National Academy of Public Administration for a review of NSF's research centers.

FY 1994 CURRENT PLAN - LEVEL OF FUNDING BY PROGRAM (continued)

(Dollars in Thousands)

PROGRAM ELEMENT	FY 1993 ACTUAL	FY 1994 REQUEST	FY 1994 CURRENT PLAN	DIFFERENCE PLAN/REQUEST AMOUNT	PERCENT
UNITED STATES POLAR RESEARCH PROGRAMS					
U.S. Arctic Research Program	$22,100	$26,200	$25,200	($1,000)	-3.8%
U.S. Antarctic Research Program	$26,730	$28,480	$28,480	$0	0.0%
Operations and Science Support	$72,850	$108,420	$104,420	($4,000)	-3.7%
U.S. Antarctic Logistical Support 1/	$59,100	$0	$0	$0	N/A
Total, U.S. Polar Research Programs	$180,780	$163,100	$158,100	($5,000)	-3.1%
UNITED STATES ANTARCTIC LOGISTICAL SUPPORT ACTIVITIES					
U.S. Antarctic Logistical Support	$0	$59,100	$56,600	($2,500)	-4.2%
Safety, Environment and Health	$14,070	$6,000	$6,000	$0	0.0%
Aircraft Procurement	$49,360	$0	$0	$0	N/A
Total, U.S. Antarctic Logistical Support Activities	$63,430	$65,100	$62,600	($2,500)	-3.8%
CRITICAL TECHNOLOGIES INSTITUTE	$1,000	$1,000	$1,500	$500	50.0%
Subtotal, RESEARCH AND RELATED ACTIVITIES	$2,080,388	$2,434,000	$2,220,700	($213,300)	-8.8%
Carryover		$0	$5,527	$5,527	N/A
Total, RESEARCH AND RELATED ACTIVITIES	$2,080,388	$2,434,000	$2,226,227	($207,773)	-8.5%

1/ Moved to U.S. Antarctic Logistical Support Activities in FY 1994

EDUCATION AND HUMAN RESOURCES

The FY 1994 appropriations act provided a total of $569.6 million, or 17 percent above the level appropriated for FY 1993 for the Education and Human Resources appropriation.

Consistent with the guidance provided by the conferees:

- $7.5 million has been added to the Experimental Program to Stimulate Competitive Research program;
- a total of $10 million has been added to the Undergraduate Education and Elementary, Secondary and Informal Science Education Activities for the advanced technological education program, which brings NSF's total effort for this new program to a level of $14.6 million;
- $1.5 million has been added to the Systemic Reform Activity for the start of a rural systemic initiative in math and science education; and
- $1.0 million has been added to the Human Resources Development Activity to augment NSF's minority summer science camps program.

As directed by the conferees, $3 million was reduced from the curriculum development program in the Elementary, Secondary, and Informal Science Education Activity and $3.5 million was taken as a general reduction across the Activities.

FY 1994 CURRENT PLAN - LEVEL OF FUNDING BY PROGRAM (continued)

(Dollars in Thousands)

PROGRAM ELEMENT	FY 1993 ACTUAL	FY 1994 REQUEST	FY 1994 CURRENT PLAN	DIFFERENCE PLAN/REQUEST AMOUNT	DIFFERENCE PLAN/REQUEST PERCENT
EDUCATION AND HUMAN RESOURCES					
SYSTEMIC REFORM					
Educational System Reform	$57,640	$78,560	$78,060	($500)	-0.6%
Experimental Program to Stimulate Competitive Research (EPSCoR)	$24,647	$24,420	$31,920	$7,500	30.7%
Total	$82,287	$102,980	$109,980	$7,000	6.8%
ELEMENTARY, SECONDARY AND INFORMAL EDUCATION					
Student Support	$11,305	$11,000	$11,000	$0	0.0%
Curriculum Development	$40,182	$45,450	$44,120	($1,330)	-2.9%
Teacher Enhancement and Development	$98,586	$106,500	$108,160	$1,660	1.6%
Informal Science Education	$34,611	$35,000	$35,000	$0	0.0%
Total	$184,684	$197,950	$198,280	$330	0.2%
UNDERGRADUATE EDUCATION					
Curriculum and Laboratory Development	$41,559	$48,430	$55,010	$6,580	13.6%
Teacher and Faculty Development	$20,349	$26,410	$26,000	($410)	-1.6%
Total	$61,908	$74,840	$81,010	$6,170	8.2%
GRADUATE EDUCATION AND RESEARCH DEVELOPMENT					
Graduate Student Support	$77,373	$58,790	$58,790	$0	0.0%
Faculty Development	$8,043	$7,670	$7,670	$0	0.0%
Total	$85,416	$66,460	$66,460	$0	0.0%
HUMAN RESOURCE DEVELOPMENT					
Precollege Education	$14,876	$13,830	$14,830	$1,000	7.2%
Undergraduate Student Support	$19,167	$26,010	$25,510	($500)	-1.9%
Institutional Support	$12,592	$15,450	$15,450	$0	0.0%
Model and Experimental Programs	$2,978	$10,600	$10,600	$0	0.0%
Total	$49,613	$65,890	$66,390	$500	0.8%
RESEARCH, EVALUATION AND DISSEMINATION					
Research	$15,649	$14,790	$14,390	($400)	-2.7%
Evaluation	$5,637	$8,970	$8,970	$0	0.0%
Dissemination and Technology Utilization	$19,869	$24,220	$24,120	($100)	-0.4%
Total	$41,155	$47,980	$47,480	($500)	-1.0%
Subtotal, EHR	$505,063	$556,100	$569,600	$13,500	2.4%
Carryover			$7,077		N/A
Total, EHR	$505,063	$556,100	$576,677	$20,577	3.7%

ACADEMIC RESEARCH INFRASTRUCTURE

The FY 1994 appropriations act provided NSF with $110 million for this activity. The FY 1994 Current Plan assumes $100 million for this activity due to the proposed rescission to which the Administration has not objected. Half of the funds will be used to help colleges and universities acquire state-of-the-art instrumentation for research and research training. The other half will be used to assist in the modernization of the research and research training facilities at the Nation's colleges and universities. For FY 1994, Ph.D. granting institutions will continue to be asked to provide at least 50 percent of total eligible project costs. However, consistent with Congressional guidance, cost sharing requirements for non-Ph.D. granting institutions will be relaxed, but the extent of cost sharing will be considered in the merit review process.

SALARIES AND EXPENSES

The $118.3 million appropriated for Salaries and Expenses represents a reduction of $7.5 million, 6 percent, from the FY 1994 Budget Request. This amount will, however, be sufficient to support our on-board staff (including locality pay), fund increased administrative costs associated with the relocation of the Foundation to Arlington, VA, and enhance information systems.

Millions of Dollars

	FY 1994 Request	FY 1994 Current Plan	Change
Personnel Compensation and Benefits	$83.80	$80.75	($3.05)
General Operating Expenses			
Travel	4.00	3.00	(1.00)
Information Systems	11.40	8.37	(3.03)
Other General Expenses	26.60	26.18	(0.42)
Subtotal, General Operating Expenses	$42.00	$37.55	($4.45)
Total, Salaries and Expenses	$125.80	$118.30	($7.50)
FTE CEILING	1,203	1,203	0

Personnel Compensation and Benefits (PC&B): $3.05 million of the reduction has been applied to Personnel Compensation and Benefits (PC&B), resulting from the Foundation's decision to meet in administrative operations and enhance information infrastructure rather than to fully fund its authorized employment ceiling of 1,203 full-time equivalents (FTEs) .

General Operating Expenses (GOE): a further reduction of $4.45 million is applied to General Operating Expenses including:

- a reduction in travel expenses from $4.00 million to $3.00 million consistent with the need to redirect funds into information infrastructure in order to maintain current services levels.

- an overall reduction of $3.00 million in Information Systems, partially offset by $1.20 million available from FY 1993 funds which were applied to forward fund FY 1994 contracts for central facility management and operations, and the customer service center. The additional reduction of $1.80 million caused a deferral of plans to transition from pilot status to full implementation in advanced automation and work processing, including telecommuting imaging, and high-speed data communications.

- a decrease of $0.42 million for Other General Operating Expenses associated with a reduction in administrative contracts for equipment repair and maintenance, furniture repair, and miscellaneous small contracts.

OFFICE OF INSPECTOR GENERAL

The Office of Inspector General (OIG) will be funded at $3,997,000 as provided in the appropriations act. This amount is $310,000 above last year's level and $103,000 less than the FY 1994 Request.

NSF HEADQUARTERS RELOCATION

The relocation of the Foundation to Arlington, VA was completed in January 1994 with all of the staff in the new facility. The $5.2 million appropriated, which represents the amount requested, will be used to reimburse the General Services Administration for expenses incurred by GSA as a result of the Foundation's relocation.

FY 1994 CURRENT PLAN - LEVEL OF FUNDING BY PROGRAM (continued)

(Dollars in Thousands)

PROGRAM ELEMENT	FY 1993 ACTUAL	FY 1994 REQUEST	FY 1994 CURRENT PLAN	DIFFERENCE PLAN/REQUEST AMOUNT	DIFFERENCE PLAN/REQUEST PERCENT
ACADEMIC RESEARCH INFRASTRUCTURE	$49,754	$55,000	$100,000 1/	$45,000	81.8%
Carryover	$0	$0	$620	$620	N/A
Total	$49,754	$55,000	$100,620	$45,620	82.9%
SALARIES AND EXPENSES	$110,838	$125,800	$118,300	($7,500)	-6.0%
NSF HEADQUARTERS RELOCATION	$0	$5,200	$5,200	$0	0.0%
OFFICE OF INSPECTOR GENERAL	$3,687	$4,100	$3,997	($103)	-2.5%
Subtotal, NATIONAL SCIENCE FOUNDATION	$2,749,726	$3,180,200	$3,017,797	($162,403)	-5.1%
Carryover	$0	$0	$13,224	$13,224	N/A
TOTAL, NATIONAL SCIENCE FOUNDATION	$2,749,726	$3,180,200	$3,031,021	($149,179)	-4.7%

1/ FY 1994 Current Plan amount excludes $10 million as proposed for rescission by the United States Congress.

RESEARCH AND RELATED ACTIVITIES $2,348,700,000

The FY 1995 Budget Request for the Research and Related Activities (R&RA) appropriation is $2,348.70 million, an increase of $180.00 million, or 8.3 percent, over the FY 1994 level of $2,168.70 million, excluding funds for Major Research Equipment. In FY 1995, R&RA will support activities that produce new knowledge necessary to address a range of national priorities and to advance our understanding of many types of scientific phenomena and technological processes. These activities also contribute directly to strengthening the scientific and technical workforce and represent a vital investment in the nation's future.

(Millions of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Change Amount	Change Percent
Biological Sciences	271.33	288.78	313.94	25.16	8.7%
Computer and Information Science and Engineering	215.60	240.58	273.50	32.92	13.7%
Engineering	256.05	295.17	320.41	25.24	8.6%
Geosciences	381.60	403.87	443.09	39.22	9.7%
Mathematical and Physical Sciences	585.86	619.85	657.72	37.87	6.1%
Social, Behavioral, and Economic Sciences	90.67	98.25	112.61	14.36	14.6%
U.S. Polar Research Programs	180.78	158.10	162.83	4.73	3.0%
U.S. Antarctic Logistical Support Activities	63.43	62.60	62.60	0.00	0.0%
Critical Technologies Institute	1.00	1.50	2.00	0.50	33.3%
Major Research Equipment 1/	[34.07]	[52.00]	0.00	[70.00]	[-100.00%]
TOTAL, R&RA	$2,046.32	$2,168.70	$2,348.70	$180.00	8.3%

1/ Major Research Equipment (MRE) appropriation is proposed in FY 1995 to fund the construction of major research equipment currently funded through the Research and Related Activities appropriation. For comparability, the FY 1993 and FY 1994 amounts for these construction projects are shown in MRE.

The Research and Related Activities appropriation funds a broad range of activities focused on strengthening the nation's scientific, mathematics, and engineering research enterprise.

- The **Biological Sciences** (BIO) Activity promotes understanding of the underlying principles and mechanisms governing living organisms. Research areas include analyses of the genetic and molecular processes underlying all life; the use of cutting-edge tools to understand organismal development and behavior; modeling of the interrelationships among organisms and the environment in which they live; and the development of new instruments and databases for the biological sciences. The 8.7 percent increase in FY 1995 will primarily support research in the U.S. Global Change Research Program and High Performance Computing and Communications, allowing enhanced support for research on biodiversity and the environment, Long Term Ecological Research sites, and the establishment of a Center for Ecological Analysis and Synthesis.

- Research in the **Computer and Information Science and Engineering** (CISE) Activity is directed at information processing in the broadest sense, ranging from fundamental theory of computing to systems architecture and engineering. In addition, significant attention is devoted to advanced computer and communications facilities providing services for the general research and education community. The 13.7 percent increase in FY 1995, directed toward the High Performance Computing and Communications initiative, enhances support for its Information Infrastructure Technology and Applications component, increases high performance computing capabilities at NSF Supercomputer Centers, and provides for a transition to very high-speed networking.

- The **Engineering** (ENG) Activity promotes the progress of engineering and increases its potential to respond to the nation's future technological opportunities and needs. ENG accomplishes its mission by supporting all fields of engineering education and research and by developing the nation's engineering human resources and physical infrastructure. Engineering's 8.6 percent increase for FY 1995 will go to support increases in Advanced Manufacturing Technology and High Performance Computing and Communications, and to meet mandated levels for the Small Business Innovation Research (SBIR) program.

- The **Geosciences** (GEO) Activity supports research to advance knowledge of the properties and dynamics of the planet Earth including: studies of geologic forces and their history; ocean dynamics and resources; and the physics and chemistry of the atmosphere. The 9.7 percent increase in FY 1995 reflects emphasis on the U.S. Global Change Research Program and will enable new and enhanced efforts in international data projects, forecasting and climate modeling, terrestrial ecology, and integrated assessments.

- The **Mathematical and Physical Sciences** (MPS) Activity supports research in mathematics, astronomy, physics, chemistry, and materials science to accelerate the growth of the knowledge base and to connect it to potential users. Major equipment and instrumentation such as accelerators and telescopes are provided to support the research needs of individual investigators. The 6.1 percent increase in FY 1995 will strengthen support and boost MPS participation in all interagency and NSF research initiatives and enhance support for facilities and instrumentation.

- The **Social, Behavioral and Economic Sciences** (SBE) Activity stimulates scientific progress in the social, behavioral and economic sciences. Research focuses on how various social and economic systems are organized and operate and how cognitive and cultural factors influence human behavior. The Activity also includes programs that promote international scientific cooperation and provide authoritative data on science and engineering and the characteristics of the nation's research and education enterprise. The 14.6 percent increment in FY 1995 will primarily support the U.S. Global Change Research Program.

- Polar Programs, which includes the **U.S. Polar Research Programs** and **U.S. Antarctic Logistical Support Activities**, support multi-disciplinary research in arctic and antarctic regions. Polar regions play a critical role in world weather and climate and provide unique research opportunities from the ocean bottom through the ice layer and into space. Special logistical and operations efforts are required to support research in Antarctica because of its remote location and the necessity of providing all infrastructure. The 2.1 percent increase in Polar Programs will be directed entirely to research projects rather than logistics. This represents an 8.8 percent increase in research and will enable expanded studies in arctic and antarctic regions, focused primarily on global change and environmental issues.

- The **Critical Technologies Institute** is a Federally-Funded Research and Development Center that provides analytical support to the Office of Science and Technology Policy by identifying near-term and long-term objectives for research and development; analyzing the production capability and economic viability of technologies; and providing options for achieving R&D objectives.

Modes of Support

NSF supports research activities through many modes, including awards for individuals and small groups of investigators with their associated equipment, postdoctoral researchers and students; research centers; national user facilities; development and acquisition of instrumentation for individual or shared use; postdoctoral fellowships; and workshops and conferences. R&RA also provides support for activities such as international scientific partnerships, research activities in the arctic and antarctic regions, and collection and dissemination of information on research in science and technology.

(Millions of Dollars)

	FY 1994 Estimate	FY 1995 Estimate	Percent Change
Research Project Support	1,275.16	1,405.92	10.3%
Centers	176.53	184.26	4.4%
Facilities 1/	527.64	559.33	6.0%
Education and Training	189.37	199.19	5.2%
Total, R&RA 1/	$2,168.70	$2,348.70	8.3%

1/ For comparability, the Facilities and Total lines do not include the LIGO and Gemini projects totaling $52.0 million in FY 1994 and $70.0 million in FY 1995. These projects are funded in the Major Research Equipment MRE) Subactivity in R&RA prior to FY 1995. In FY 1995, these construction projects are proposed to be assigned to a new Major Research Equipment account.

The merit review system is the principal tool in selecting proposals for funding, emphasizing the capabilities of the investigators; the innovation, importance and relevance of the ideas and approaches; and the potential for enhancing the human and physical infrastructure of science and engineering.

Roughly $1,405 million, or approximately 60 percent, of R&RA is designated for support of individual investigator and small group research projects in both traditional disciplinary areas and fields of national importance. NSF's strategy is to maintain a balance within R&RA between overlapping needs: disciplinary and interdisciplinary fields; fundamental research and research in areas of national priority; and mature and emerging fields. NSF also participates in federal interagency efforts such as the National Earthquake Hazards Reduction Program and the Human Capital Initiative.

About $560 million, or 24 percent, of the R&RA funding supports unique national facilities such as telescopes, research ships, accelerators, and supercomputers, all of which enable a broad range of research activities, including research in strategic areas.

Support for national centers in various disciplines totals nearly $185 million in FY 1995, or approximately 8 percent of the R&RA total. These centers encourage the growth of strong partnerships among academia, industry and government, such as the State/Industry/University Cooperative Research Centers.

Almost $200 million, or about 8 percent, of R&RA goes to innovative programs which support science, mathematics, and engineering education and training at the undergraduate, graduate, and post-doctoral levels. Programs include Research Experiences for Undergraduates, Engineering Education Coalitions, Graduate Fellowships for Women in Engineering, and Postdoctoral Fellowships. NSF support for education and training within R&RA, however, is even greater than the above table implies. Research projects, centers, and facilities all include additional funding for graduate and undergraduate students and postdoctoral researchers. In addition, items such as workshops, travel grants, colloquia and symposia all have a training component.

Research in Strategic Areas

Recognizing the dynamic relationship between research and technology and the benefits they can provide to society, research and education initiatives in strategic areas form an integral and increasingly important part of the R&RA portfolio. These interagency and NSF initiatives cut across virtually all of the activities included within R&RA. NSF's ability to focus and concentrate many disciplines on the priorities expressed by these initiatives is a major factor in its leadership role in the interagency initiatives.

FY 1995 support within R&RA toward NSF's funding for research in strategic areas and the federal interagency initiative for science, math, engineering, and technology education increases approximately $164 million, or about 12 percent, over the FY 1994 planned level.

(Millions of Dollars)

	FY 1994 Estimate	FY 1995 Estimate	Percent Change
Advanced Manufacturing Technology	191.10	196.27	2.7%
Advanced Materials & Processing Program	303.98	306.08	0.7%
Biotechnology	187.69	193.89	3.3%
Civil Infrastructure Systems	51.10	54.10	5.9%
Environmental Research	144.44	156.04	8.0%
High Performance Computing & Communications	249.67	310.75	24.5%
Science, Math, Engineering and Technology Education	109.33	118.53	8.4%
U.S. Global Change Research Program	141.90	207.52	46.2%

Note: Projects which have strong connections to the goals and objectives of more than one initiative are difficult to attribute to single initiative. In an effort to present a more precise measure of its research and education initiatives, NSF will redefine its internal data collection and analysis capabilities so that the allocation of resources for these initiatives can be shown in a mutually exclusive manner.

NSF's primary focus in these initiatives is on the fundamental research needed to generate new scientific, mathematics, and engineering knowledge and to further progress in these areas. The discoveries that stem from such research become the foundation for broad and useful applications of knowledge and development of new technologies. These initiatives in strategic areas are central to the long-term economic growth and technological development of the nation and will lead to improvements in areas ranging from understanding of the global climate system and environment, to technologies for advanced manufacturing, to new information technologies, to civil infrastructure systems and materials processing.

Networking, building capability in the supercomputer centers, and the uses of technology in education are important components of NSF's leadership in the **High Performance Computing and Communications** initiative. Additional emphasis will be placed on the **Information Infrastructure Technology and Applications** effort which provides the critical technological underpinning of the Administration's National Information Infrastructure initiative. Included is transition to very high-speed networking, research on national challenge application problems, expansion of metacenter and regional affiliates activities, and an increase in Grand Challenge Applications, digital libraries, and software research for scalable parallel computing systems.

NSF's support for the **U.S. Global Change Research Program** focuses on improving knowledge of fundamental physical, biological, and socioeconomic processes related to global change. Special attention will be given in FY 1995 to major international data collection and analytic programs; climate change modeling and forecasting activities; research on terrestrial ecology; research on policy processes; and the advancement of methods for conducting integrated assessments.

Number of People Involved in Research and Related Activities

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Senior Researchers	18,500	19,500	20,400
Other Professionals	6,500	6,700	7,000
Post-Doctorates	4,000	4,200	4,500
Graduate Students	15,500	16,200	16,800
Undergraduate Students	6,500	6,900	7,300
K-12 Teachers	100	100	100
K-12 Students	100	100	100
Total Number of People	51,200	53,700	56,200

R&RA Funding Profile

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Total Number of Awards	15,876	16,365	17,117
Statistics for Competitive Awards:			
Number	7,696	7,900	8,200
Funding Rate	31%	31%	31%
Median Annualized Award Size	$51,631	$55,500	$59,500
Average Annualized Award Size	$75,968	$80,000	$84,500
Average Duration (yrs.) 1/	2.7	3.0	3.0

1/ Average Duration includes research projects only.

CHANGES IN BUDGET STRUCTURE

Responding to the Administration's efforts to reduce the number of appropriations, four existing appropriations accounts have been merged to create a new Research and Related Activities (R&RA) account. The new R&RA account includes: Research and Related Activities, U.S. Polar Research Programs, U.S. Antarctic Logistical Support Activities, and the Critical Technologies Institute. Also, starting in FY 1995, major research equipment currently funded in the R&RA Activity will become a separate Major Research Equipment Activity for large construction projects.

FY 1995 Crosswalk

(Dollars in Thousands)

	New Structure		
Old Structure	**Research and Related Activities**	**Major Research Equipment**	**Total, Old Structure**
Research and Related Activities	2,121,270	70,000	$2,191,270
U.S. Polar Research Programs	162,830		$162,830
U.S. Antarctic Logistical Activities	62,600		$62,600
Critical Technologies Institute	2,000		$2,000
Total, New Structure	$2,348,700	$70,000	$2,418,700

BIOLOGICAL SCIENCES $313,940,000

The FY 1995 Budget Request for the Biological Sciences Activity (BIO) is $313.94 million, an increase of $25.16 million, or 8.7 percent, over the FY 1994 Current Plan of $288.78 million.

(Millions of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Change Amount	Change Percent
Molecular and Cellular Biosciences	81.14	85.09	91.05	5.96	7.0%
Integrative Biology and Neuroscience	74.28	77.87	83.72	5.85	7.5%
Environmental Biology	70.16	74.80	83.30	8.50	11.4%
Biological Instrumentation and Resources	45.74	51.02	55.87	4.85	9.5%
TOTAL, BIO	$271.32	$288.78	$313.94	$25.16	8.7%

The Biological Sciences Activity fosters understanding of the underlying principles and mechanisms governing life. Research ranges from the study of the structure and dynamics of large biological molecules, such as proteins and nucleic acids, through cells, organs and organisms, to studies of populations and ecosystems. It encompasses processes that are internal to the organism as well as those that are external, and includes temporal frameworks ranging from measurements in real time through individual life spans, to the full scope of evolutionary time.

The highest priority within the BIO Activity is to ensure the vitality of the biological sciences in U.S. colleges and universities, especially in those areas where NSF has major responsibility. The Foundation is the nation's principal supporter of fundamental academic research in biodiversity, environmental biology and plant biology, providing over 95, 75, and 50 percent respectively, of the support in these areas. BIO emphasizes support for investigators beginning new lines of research, high risk/high potential projects, and exploratory studies. Additionally, the Activity supports infrastructure and research resource development for the biological sciences such as multi-user instrumentation, living stock centers, systematic collections, and computerized databases.

BIO support focuses on:

New knowledge at the cutting edge of the biological sciences. The *Arabidopsis* genome research project is a ten year multinational initiative organized by BIO in 1991. Its goal is to understand the function of every gene in the plant. In the U.S., it is a coordinated effort of four agencies (NSF, USDA, DOE and NIH) with NSF as lead agency. Standing out among many advances is the identification and cloning of genes involved in the pathway to flower development, thus allowing researchers to manipulate and control such crucial aspects as the timing and position of flower formation. This knowledge is applicable to other plants, including vegetables and fruits where floral development results in economic crops.

Participation of biologists in solutions to national problems. Loss of biodiversity is a problem of great national and international import. Research in all of the BIO Subactivities is being brought to bear on this problem. For example, experiments at the Cedar Creek Long Term Ecological Research site in Minnesota demonstrated the importance of biodiversity on plant production following the major drought of 1988. Areas previously manipulated to contain high plant diversity maintained higher plant production during the drought and recovered more rapidly than less diverse areas. This study demonstrates the value of biodiversity to ecosystem management.

Provision of fundamental knowledge to support biotechnological advances. The Nobel Prize for Physiology or Medicine for 1993 was awarded for the development of the Polymerase Chain Reaction (PCR), a technique for amplifying DNA that is now a fundamental tool for all of biotechnology. The high-temperature biomolecule that made this technique possible was isolated from a bacterium found in hot springs in Yellowstone Park by a BIO-supported researcher who was examining how organisms are able to live at near-boiling temperatures. This discovery exemplifies the importance of biodiversity in providing raw materials for biotechnology.

Innovation in developing techniques of utility to all biologists. Biologists and computer scientists have developed new microscopes, linked by high-speed computer networks, that enable researchers in biology and other fields to enhance their observations and share their work over great distances. New microscopes compress the time required to produce full three-dimensional images from hours to seconds, and allow researchers to perform studies remotely from thousands of miles away, using computer networks. The combined technologies allow sharing of expensive resources while providing nationwide access to powerful scientific tools.

Education of the biologists and informed citizenry of the future. Through its Research Training Groups (RTG) awards, BIO supports focused training activities by small groups of faculty and students. These awards provide in-depth training in several related disciplines, at least one of which must be biological. For example, the RTG in Paleorecords of Global Change brings together experts in geology, ecology and anthropology for a well-defined training program at the undergraduate, graduate and postdoctoral levels. Graduates of the program are able to use the techniques and paradigms of all three disciplines in research aimed at understanding the dynamics of ecosystem response to global change.

As another example, the Science and Technology Center for Engineering Plants for Resistance against Pathogens has developed an interactive software program, called "Germ Wars," that teaches the principles of microbial interactions with plants and animals. The program is currently displayed at the EPCOT Center in Florida, is being tested in local high schools, and will be distributed nationally.

Research in Strategic Areas

Examples of research in strategic areas include:

(Millions of Dollars)

	FY 1994 Estimate	FY 1995 Estimate	Percent Change
Advanced Materials and Processing Program	8.18	8.18	0.0%
Biotechnology	116.11	120.61	3.9%
Environmental Research	71.02	73.12	3.0%
High Performance Computing & Communication	10.00	17.06	70.6%
Science, Math, Engineering and Technology Education	26.71	26.71	0.0%
U.S. Global Change Research Program	9.85	21.35	116.8%

Note: Projects which have strong connections to the goals and objectives of more than one initiative are difficult to attribute to single initiative. In an effort to present a more precise measure of its research and education initiatives, NSF will redefine its internal data collection and analysis capabilities so that the allocation of resources for these initiatives can be shown in a mutually exclusive manner.

The Biological Sciences FY 1995 Budget Request includes:

- Research in the **Advanced Materials and Processing Program** will continue at its current level of $8.18 million.
- Research in **Biotechnology** continues to be an important BIO initiative, totaling $120.61 million in FY 1995, an increase of $4.50 million over FY 1994. Ongoing activities include support for research in five priority areas: environmental biotechnology, bioprocessing, bionetworks, plant biotechnology, and marine biotechnology. Biotechnology research crosses all Subactivities within BIO and ranges from support of large projects such as the Center for Molecular Biotechnology to major coordinated activities such as the multinational *Arabidopsis* Plant Genome Project and the interagency Plant Science Initiative, in collaboration with USDA and DOE.

New activities in FY 1995 will enhance support for research focusing on the plant genome project and on environmental biotechnology, including such topics as biochemical, cellular and genetic mechanisms that provide the general foundations for biotechnology, especially plant and microbial metabolism; and analysis of plant secondary metabolites, many of which have been shown to have a wide variety of applications, e.g. biomaterials, industrial chemicals, flavor compounds, pharmaceuticals, and pesticides.

- **Environmental Research** is an Activity priority and totals $73.12 million in FY 1995, an increase of $2.10 million over FY 1994. Ongoing emphases include environmental biology, biodiversity, conservation biology, integrated regional modeling and environmental data management. Core support for the Long Term Ecological Research sites (LTERs) is a significant component of BIO's support for research on the environment. Interagency activities have been developed in these areas including: International Biodiversity Studies with the Agency for International Development (AID) ; and a Memorandum of Understanding with AID, the National Institutes of Health (NIH) and the National Institutes of Mental Health (NIMH) on Drug Discovery, Biodiversity Conservation and Sustainable Development.

  New activities in FY 1995 will support additional research on the genetic, biophysical and cellular mechanisms by which organisms respond to environmental signals; on the genes involved in plant-pest interactions; on biodiversity and its role in maintaining the health of the environment; and on the support of biological field stations and marine laboratories.

- Research in the **High Performance Computing and Communications (HPCC) initiative** totals $17.06 million in FY 1995, an increase of $7.06 million over FY 1994. Ongoing activities include support for computational biology and databases, with emphasis in the areas of ecology, neuroscience, cell biology, and structural biology. This total includes infrastructural support for the biological sciences via participation in the Grand Challenge Application Groups competition, e.g., High Performance Computing for Land Cover Dynamics; Massively Parallel Simulation of Large-Scale, High-Resolution Ecosystem Models; and Computational Biomolecular Design. Also included is support for biologically related activities at the NSF supercomputer centers.

  New activities in FY 1995 will support additional research in HPCC, including the **Information Infrastructure Technology and Applications (IITA)** component. In particular, BIO will support a new round of Grand Challenges as well as a complementary round of National Information Infrastructure Challenges. Additionally, BIO will provide substantial enhancement for IITA to include support for networking via a Center for Ecological Analysis and Synthesis and support for large database resources such as the protein data bank and computational neuroscience that will be part of the biological information infrastructure.

- **Science, Mathematics, Engineering, and Technology Education,** an interagency initiative, remains a top priority of the BIO Activity. In FY 1995 support for programs and initiatives in this area will total $26.71 million. Programs in support of undergraduate education total $15.3 million. Those programs include: Research Experiences for Undergraduates (REU), both "sites" awards that provide funding for groups of undergraduates focused on a particular biological topic, and supplements to allow participation of one or two undergraduates on regular BIO research projects; Research at Undergraduate Institutions, providing research support to faculty and students at undergraduate institutions; and Research Opportunity Awards that provide support for faculty at undergraduate institutions to work on NSF supported projects at research universities.

  Programs in support of graduate/postdoctoral training total $11.34 million. Those activities include: the Research Training Groups (RTGs) which provide multidisciplinary research training to teams of scientists and students; and postdoctoral awards in plant biology, environmental biology, and for minority scientists. In FY 1995, BIO intends to shift emphasis in Postdoctoral support to a new program of awards for Postdoctoral Training in Environmental Research. This new program, spanning all Subactivities, will emphasize multidisciplinary training for research on the environment.

- Research in the **U.S. Global Change Research Program (USGCRP)** totals $21.35 million in FY 1995, an increase of $11.50 million over FY 1994. Ongoing activities include programs for Ecological Rates of Change (EROC), dynamics of Water, Energy, Air and VEgation (WEAVE), and

Land-Margin Ecosystem Research (LMER) supported through the research programs in the Environmental Biology Subactivity.

A new emphasis in the FY 1995 USGCRP is expanded support for terrestrial ecology. Research programs in biodiversity, including microbial diversity, and molecular evolution are included. Enhanced support at the Long Term Ecological Research Sites (LTERs) will target research related to global change.

The BIO Activity also supports a number of other education, training and human resource development programs.

Modes of Support

BIO supports its ongoing and new activities through the following modes:

(Millions of Dollars)

	FY 1994 Estimate	FY 1995 Estimate	Percent Change
Research Projects	231.19	251.25	8.7%
Centers	23.98	28.98	20.9%
Facilities	0.00	0.10	n/a
Education & Training	33.61	33.61	0.0%
Total, BIO	$288.78	$313.94	8.7%

Research Projects

The BIO Activity supports over 2,500 individual investigator initiated research projects, predominantly in colleges and universities across the United States. Research supported spans all the biological disciplines represented within the BIO Subactivities. Particular emphasis is placed on fields of research where NSF/BIO has major responsibility, such as plant and environmental biology; on research support for beginning investigators; and on projects with an emphasis on education and training of future scientists for careers in academe, industry and government. Approximately one-third of all new competitive research projects supported by BIO are to new investigators.

An average research project within the BIO Activity in FY 1995 is estimated to be $240,000 over three years of support. Support characteristically includes funds for supplies, small pieces of equipment, communications, a stipend for a graduate student or postdoctoral associate, hourly wages for undergraduates, and about two months summer salary for the principal investigator.

In recent years, investigators funded by BIO have:

- Discovered what may be the most abundant organism on earth, a deep-sea bacterium (occurring from 500 to 3,000 meters deep), numbering more than 500 individuals per drop of sea water. Discovery of this previously unknown microbe shows that our understanding of the biodiversity of earth and knowledge of microbial diversity is far from complete.

- Found a key developmental pathway common to both insects and mammals. These signal transduction pathways control such disparate functions as central nervous system development and skeletal muscle formation. Increased understanding of these pathways should lead to fresh insights not only into these structures and their functions but also into their origin and evolution.

- Isolated a key gene controlling the intake of potassium and of toxic metals in plants. Potassium, one of the most important nutrients absorbed by plants through soil, plays a major role in the growth of crops. This research will lead to the development of genetically engineered plants capable of blocking sodium and other toxic metals such as aluminum from entering plants. These harmful substances are responsible for major agricultural losses.

The BIO Activity also supports infrastructural and research resource needs of the biological sciences. This includes support for living stock centers, marine laboratories and terrestrial field stations, databases, multi-user instrumentation, and development of instrumentation and new techniques. For example, a BIO-funded investigator has recently perfected a new type of optical microscope that allows researchers to observe the inner workings of individual living cells. This standing wave microscope can resolve structures as small as 50 nanometers in size (a nanometer is one-billionth of a meter).

Centers

BIO-supported centers include Science and Technology Centers, Long Term Ecological Research sites, and support for a Center for Ecological Analysis and Synthesis.

(Millions of Dollars)

	FY 1994 Estimate	FY 1995 Estimate	Percent Change
Science and Technology Centers	11.98	11.98	0.0%
Center for Ecological Synthesis and Analysis	1.00	2.00	100.0%
Long Term Ecological Research Sites	11.00	15.00	36.4%
Total Center Support, BIO	$23.98	$28.98	20.9%
Number of Researchers	250	300	20.0%
Number of Students	320	400	25.0%

The BIO Activity supports six Science and Technology Centers (STCs). They include the Centers for: Molecular Biotechnology, supported in the Biological Instrumentation and Resources Subactivity; Microbial Ecology, supported in the Environmental Biology Subactivity; two centers supported in the Integrative Biology and Neuroscience Subactivity, one for Magnetic Resonance Technology and one for Biological Timing; and two centers supported in the Molecular and Cellular Biosciences Subactivity, one for Light Microscope Imaging and Biotechnology and one for Engineering Plants for Resistance Against Pathogens.

The BIO STCs directly support over 45 researchers and 70 students, including all levels from undergraduate to postdoctoral. Many other scientists and students are involved in research supported by the STCs but do not receive any direct salary support from the centers. Each of the centers supports a variety of education programs and has specific community outreach responsibilities. As an example, the educational outreach program of the Center for Microbial Ecology has enhanced the exposure of high school students in the Detroit public school system to scientific research and scientist role models. Through field trips and classroom presentations, using a multi-media program entitled "The Unseen World", 420 high school students were introduced to the microbial world and learned about current research in ecology and biotechnology. Workshops attended by 57 K-12 teachers (primarily high school) focused on broadening the content of the science curriculum while year-round collaboration between center researchers and eight high school teachers led to the development of educational materials that transmit the excitement and challenge of science. Emphasis is also placed on ensuring balanced representation among both researchers and students.

Collaborative arrangements with industry are strongly pursued by all STCs. Some recent results of these collaborations include the commercial development of software packages, invention of specialized computer chips, development of advanced instrumentation for biotechnology, and receipt of several patents for bioremediation technologies.

BIO also provides support for 16 Long Term Ecological Research (LTER) sites through the Environmental Biology Subactivity. Two additional sites in Antarctica are supported by the U.S. Polar Research Programs Activity. The 18 sites, representing major ecosystems, support interdisciplinary projects requiring long periods of study. Extensive computer networking among sites promotes data sharing and modeling and encourages regional, national and international synthesis efforts. Sites range widely from the Arctic tundra of Alaska, to the desert of New Mexico, to the tropical rain forest in Puerto Rico. Currently 175 researchers and over 200 students are supported directly at the sites. Many other researchers work at the sites for short-term projects.

LTER sites represent "research platforms" where projects, representing many disciplines, enable interdisciplinary collaborative activities. The sustained nature of the studies also allows immediate and scientifically sound evaluations of major environmental phenomena.

In FY 1994, the BIO Activity is initiating a competition for a Center for Ecological Analysis and Synthesis (CEAS). Establishment of this center will promote integrative studies of complex ecological questions and serve as a locus for synthesis of large data sets. In FY 1995, incremental funding for the IITA initiative will facilitate networking, integrated regional modeling and training components of the CEAS.

Facilities

BIO will participate in the funding of the National Nanofabrication Users Network with the Mathematics and Physical Sciences and Engineering Activities, to facilitate participation of biologists. BIO will contribute $100,000 in FY 1995 toward support of this facility.

Education and Training

The Foundation places a high priority on programs for education, training and human resource development, both to maintain the future supply of scientists and engineers and to develop a scientifically and technologically literate populace.

(Millions of Dollars)

	FY 1994 Estimate	FY 1995 Estimate	Percent Change
K-12	0.04	0.04	0.0%
Undergraduate	15.33	15.33	0.0%
Graduate	7.34	7.34	0.0%
Post-Doctoral	4.00	4.00	0.0%
Other	6.90	6.90	0.0%
Total Education & Training, BIO	$33.61	$33.61	0.0%

The BIO Activity has a strong commitment for supporting the education and training of future scientists. This support ranges from providing first research experiences for undergraduates through the Research Experiences for Undergraduates (REU) program; to providing opportunities for contemporary, competitive research experiences for faculty and their students in the Research at Undergraduate Institutions (RUI) activity. Also included within BIO education and training is support for minority high school students; doctoral dissertation support in research areas requiring field work; postdoctoral programs; and research opportunity awards that allow faculty at small colleges to update their skills working on an NSF supported research project at a large research university.

One significant emphasis within BIO's support for education and training has been support for the Research Training Groups (RTG) program supported in the Biological Instrumentation and Resources Subactivity. This program provides support for training undergraduates, graduate students, and postdoctoral associates in a multidisciplinary research setting, focused on a particular research topic. For example, the RTG in Neural Processes in Cognition is a joint effort by a group of faculty at the University of Pittsburgh and Carnegie Mellon University. It includes experts in experimental neuroscience, computational neuroscience, and psychology to expose students to multidisciplinary approaches to understanding how the brain functions.

Another emphasis within BIO has been postdoctoral training in critical initiative areas. For several years, the Activity has supported postdoctoral programs in plant biology and environmental biology. In FY 1995, BIO will begin a new program of postdoctoral support for environmental research in place of the plant and environmental biology postdoctoral programs. This new program will span all research Subactivities.

BIO has also supported a Minority Postdoctoral program since FY 1990; this program has provided support for advanced postdoctoral training to over 30 highly qualified minority investigators with a recent Ph.D. in biology. Mentoring and follow-up are strong features of this program.

Development of human resources is another important component of the BIO Activity. Programs that seek to maximize the potential of all scientists include: programs for women, including the Career Advancement awards and Research Planning grants; programs for minorities, including Minority Research Initiation awards; and programs for new investigators, including the NSF Young Investigator (NYI) program and Presidential Faculty Fellows (PFF) program.

Number of People Involved in BIO Activities

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Senior Researchers	2,050	2,100	2,210
Other Professionals	1,150	1,200	1,270
Post-Doctorates	990	1,010	1,080
Graduate Students	1,860	1,900	2,000
Undergraduate Students	1,350	1,410	1,550
Total Number of People	7,400	7,620	8,110

BIO Funding Profile

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Total Number of Awards	2,897	2,899	2,901
Statistics for Competitive Awards:			
Number	1,328	1,330	1,330
Funding Rate	27%	27%	27%
Median Annualized Award Size	$60,000	$65,000	$72,000
Average Annualized Award Size	$68,136	$72,000	$80,000
Average Duration (yrs.) \1	2.9	3.0	3.0

1\ Average Duration limited to research projects only.

MOLECULAR AND CELLULAR BIOSCIENCES $91,050,000

The FY 1995 Budget Request for the Molecular and Cellular Biosciences Subactivity is $91.05 million, an increase of $5.96 million, or 7.0 percent, over the FY 1994 Current Plan of $85.09 million.

(Millions of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Change Amount	Change Percent
Biochemistry and Molecular Structure and Function	32.73	33.85	36.05	2.20	6.5%
Cell Biology	19.28	19.89	21.45	1.56	7.8%
Genetics and Nucleic Acids	29.13	31.35	33.55	2.20	7.0%
Total, MCB	$81.14	$85.09	$91.05	$5.96	7.0%

The Molecular and Cellular Biosciences Subactivity (MCB) supports research that increases our fundamental understanding of the structure, function, and dynamics of biological molecules and cells. It includes not only the disciplines of biochemistry, biophysics, cell biology and genetics, but promotes interdisciplinary research between these disciplines and at their interfaces with physical science, mathematics, and engineering. A recent scientific breakthrough was the isolation and cloning of a gene that confers resistance to bacterial infection in tomatoes. This represents the first time such a plant gene was isolated, cloned and used to confer resistance in a genetically engineered plant.

The Biochemistry and Molecular Structure and Function program element supports studies of the structure, function, and dynamics of proteins, nucleic acids, lipids, carbohydrates and other cell components as well as on the metabolic processes responsible for the production and degradation of biological molecules and energy. The Cell Biology program element supports studies on the structure and function of plant, animal, and microbial cells and on the cellular mechanisms by which living things respond to external stimuli. The Science and Technology Center for Light Microscope Imaging and Biotechnology at Carnegie Mellon University is supported by this program element. The Genetics and Nucleic Acids program element supports studies of the mechanisms by which inheritable information is transmitted from one generation to the next in all organisms from viruses to plants and animals. This program element supports the Science and Technology Center for Engineering Plants for Resistance against Pathogens at the University of California, Davis.

The FY 1995 Budget Request of $91.05 million includes increases in the following initiative areas which involve all program elements:

- Research at the interface between **High Performance Computing and Communications** and studies of cellular and molecular structure will increase $1.36 million. Examples include mathematical modeling of how proteins fold into the complex three-dimensional structures that provide their physical and biological properties, and development of computational techniques for simultaneous capture and rapid analysis of complex data from light microscopy.

- Research related to terrestrial ecology as part of the **U.S. Global Change Research Program** will increase $1.50 million; emphases will be: (1) biochemical, metabolic and cellular diversity of a variety of organisms, with a particular focus on microbial diversity; and (2) the evolution of biological macromolecules underlying the diversity of cellular and genetic functions carried out by living organisms.

- New research to build the knowledge base will increase $3.10 million in the following areas: (1) the genetic, biophysical and cellular mechanisms by which a variety of organisms respond to environmental stimuli will be emphasized; especially important are studies of how plants respond to environmental signals; (2) biochemical, cellular and genetic mechanisms that provide the general foundations for biotechnology will be emphasized. This includes plant and microbial metabolism, genetic studies at the molecular level, mechanisms by which microbes and cells of a variety of plants and animals produce and export proteins and other useful chemical products, and mechanisms regulating cell division.

Number of People Involved in MCB Activities

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Senior Researchers	640	650	670
Other Professionals	320	340	350
Post-Doctorates	390	400	420
Graduate Students	650	660	680
Undergraduate Students	190	200	220
Total Number of People	2,190	2,250	2,340

INTEGRATIVE BIOLOGY AND NEUROSCIENCE $83,720,000

The FY 1995 Budget Request for the Integrative Biology and Neuroscience Subactivity is $83.72 million, an increase of $5.85 million, or 7.5 percent, over the FY 1994 Current Plan of $77.87 million.

(Millions of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Change Amount	Change Percent
Physiology and Behavior	28.65	30.52	33.31	2.79	9.1%
Neuroscience	30.81	31.31	33.10	1.79	5.7%
Developmental Mechanisms	14.82	16.04	17.31	1.27	7.9%
Total, IBN	$74.28	$77.87	$83.72	$5.85	7.5%

Research supported by the Integrative Biology and Neuroscience Subactivity (IBN) involves the integration of genetic, molecular, and cellular approaches to understanding the development, functioning and behavior of organisms. Emphasis is on the use of a diversity of organisms as biological models. Scientific information gained has application in biotechnology, global change and industry. For example, researchers supported by the Subactivity studying the neurophysiology of olfaction and taste in catfish were able to identify novel compounds that control feeding in fish. This work is the basis for two patents relating to a novel feeding stimulant that is of great utility to the fisheries industry.

The Developmental Mechanisms program element emphasizes those processes that determine how organisms develop, grow, reproduce and become senescent. The Physiology and Behavior program element targets integrative studies of physiological functions at the cellular, organ system, organismic and behavioral levels. The Neuroscience program element examines all aspects of the nervous system: its structure, function, development and integration with the physiological and behavioral systems impacted by it. Two Science and Technology Centers are supported within this program element, one for Biological Timing at the University of Virginia, and one for Magnetic Resonance Imaging for Basic Biological Research at the University of Illinois. Recently, the Center for Biological Timing isolated the first mutant of a gene that regulates the 24 hour (circadian) clock in mice, and several new mutants of the circadian clock in plants. These will be exploited to better understand the internal biological clock which integrates and regulates the daily cycles of activity fundamental to the life of all organisms, including humans.

The FY 1995 Budget Request of $83.72 million includes increases in the following initiatives that cut across all program elements:

- Research in **High Performance Computing and Communications** (HPCC) will increase by $1.35 million to allow for further growth in the still emerging field of Computational Neuroscience through the support of modeling and computational tools, support of enhanced brain imaging and optical signal recording techniques.

- An increase of $1.50 million in support of research related to the **U.S. Global Change Research Program** includes activities to further understand the physiological and behavioral bases of the survival and adaptation of organisms to environmental changes; the mechanisms by which molecules which regulate development evolve and are fixed in response to changing environments (Molecular Evolution); and the diversity of microorganisms which interact with each other and with higher organisms, including microorganisms associated with plant roots and the surrounding soil. These microbes contribute to plant growth and development; however, except for the nitrogen-fixing bacteria, very little is yet known about the biological bases for these beneficial relationships.

- Additional increases of $3.00 million will allow for enhanced funding for these additional priorities: (1) plant sciences, including NSF's Plant Genome Initiative, to allow the development of a better understanding of plant-pest interactions, and research on such activities as plant "secondary metabolites", many of which have been shown to have a wide variety of commercial applications; (2) a NSF collaborative research initiative to establish new technologies for mapping the brain; (3) Biosystems Analysis and Control, a joint activity with the Engineering Activity to foster cross-disciplinary approaches and innovative technologies to analyze how biological signals are processed and controlled; (4) evolution of biological information processing systems; and (5) biotechnology, especially as applied to the environment.

Number of People Involved in IBN Activities

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Senior Researchers	620	630	660
Other Professionals	360	370	390
Post-Doctorates	320	320	340
Graduate Students	530	530	560
Undergraduate Students	520	530	570
Total Number of People	2,350	2,380	2,520

ENVIRONMENTAL BIOLOGY $83,300,000

The FY 1995 Budget Request for the Environmental Biology Subactivity is $83.30 million, an increase of $8.50 million, or 11.4 percent, over the FY 1994 Current Plan of $74.80 million.

(Millions of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Change Amount	Change Percent
Systematics and Population Biology	22.06	23.74	26.04	2.30	9.7%
Ecological Studies	23.80	26.16	27.96	1.80	6.9%
Long-Term Projects in Environmental Biology	24.31	24.90	29.30	4.40	17.7%
Total, DEB	$70.16	$74.80	$83.30	$8.50	11.4%

The Environmental Biology Subactivity (DEB) supports fundamental research on the origins, functions, relationships, interactions and evolutionary history of organisms, populations, species, communities and ecosystems. It includes support for disciplinary and interdisciplinary activities with emphases on global change, biodiversity, molecular evolution, mesoscale ecology, computational biology, integrated modeling, conservation biology and restoration ecology. The Science and Technology Center in Microbial Ecology at the University of Michigan also is supported by this Subactivity.

Activities in the Systematics and Population Biology program element include research on the patterns and causes of diversity among organisms, populations, and species. For example, research supported by this program led to the discovery that tree saplings established in clearings caused by lightning strikes survived Hurricane Andrew better than saplings growing in mature forest areas. Small disturbances, such as lightning strikes, may be important in providing populations that are more resistant to major disturbances.

The Ecological Studies program element supports research in managed and natural habitats on the structure and function of species interactions, communities and ecosystems. For example, research in Hawaii supported by this program discovered that certain exotic plant species can invade an area and eliminate native species by altering soil chemistry to enhance their own growth and survival. Understanding how exotic species become established will aid efforts to conserve native plants and the animals dependent on them.

The Long-Term Projects in Environmental Biology program element funds research on long-term ecological phenomena and supports environmental biology research infrastructure, such as Long Term Ecological Research sites (LTERs) and research collections. An example of research supported by this element was the recent discovery on the Atlantic coast barrier islands, that what was thought to be a constant pattern of erosion from the northern ends of islands and deposition on the southern ends reversed during the 1960's. This finding will directly impact coastal management policies that were based on the assumption that patterns of landform change are constant.

The FY 1995 Budget Request of $83.30 million includes increases for the following initiatives that cross-cut all program elements:

- An increase in **High Performance Computing and Communications** (HPCC) of $1.00 million will allow the Center for Ecological Analysis and Synthesis to undertake networking, integrated regional modeling, and training.

- Research in support of the **U.S. Global Change Research Program** will increase by $7.50 million in FY 1995, for a total of $17.35 million. The increase will enhance ongoing programs: Ecological Rates of Change; Water, Energy, Air, and Vegetation; and Land Margin Ecosystem Research. It will also provide new support for activities in terrestrial ecology, including Conservation Biology and Restoration Ecology; Biotic Surveys and Inventories; molecular evolution; and training in taxonomy.

Included as part of this increase is $4.00 million for the Long Term Ecological Research sites to enhance research on terrestrial ecology, to develop collaborations with similar sites in other countries, and to undertake integrated assessments and modeling.

Number of People Involved in DEB Activities

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Senior Researchers	620	640	690
Other Professionals	310	320	350
Post-Doctorates	180	180	200
Graduate Students	480	490	530
Undergraduate Students	500	520	590
Total Number of People	2,090	2,150	2,360

BIOLOGICAL INSTRUMENTATION AND RESOURCES $55,870,000

The FY 1995 Budget Request for the Biological Instrumentation and Resources Subactivity is $55.87 million, an increase of $4.85 million, or 9.5 percent, over the FY 1994 Current Plan of $51.02 million.

(Millions of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Change Amount	Change Percent
Instrumentation and Instrument Development	13.58	14.79	15.79	1.00	7%
Special Projects	32.16	36.23	40.08	3.85	11%
Total, BIR	$45.74	$51.02	$55.87	4.85	10%

The Biological Instrumentation and Resources Subactivity (BIR) supports research infrastructure across all areas of biology from molecular to ecosystem levels for both disciplinary and interdisciplinary activities. Support addresses instrumentation and other resources needed by groups of researchers, as well as training for undergraduates in biological research and fellowships for postdoctoral trainees in emerging interdisciplinary areas. Teams of biologists and computer scientists are supported to develop databases and new software applications for biology.

The Instrumentation and Instrument Development program element supports acquisition of such multi-user instrumentation as high field nuclear magnetic resonance instruments, ultracentrifuges, very high-resolution microscopes and super minicomputers. The Special Projects program element includes support for living stock collections, the *Arabidopsis* genome initiative, research training groups, postdoctoral research fellowships, research experiences for undergraduates, upgrades to biological field stations and marine laboratories, computational biology and data bases, and High Performance Computing and Communication activities. This program element also supports the Science and Technology Center for Molecular Biotechnology at the University of Washington.

The FY 1995 Budget Request of $55.87 million includes increases in the following initiatives:

- An increase of $3.35 million in the Special Projects Program for **High Performance Computing and Communications** and the **Information Infrastructure Technology and Application** (IITA) initiative will provide $1.00 million for workstations in the Instrumentation and Instrument Development Program, hardware for networking and network access, and $2.35 million in the Special Projects Program for Grand Challenges to develop algorithms and software for image generation and analysis, and to develop scientific databases of various types ranging from plant genome research data and digital libraries to spatial ecological landscape data.

- An increase of $1.00 million within the Instrumentation and Instrument Development Program for the **U.S. Global Change Research Program** will be used to support critical biological resources, including additional living stock collections, such as a collection of methane-producing microorganisms, crucial to our understanding of the relationship of biodiversity to global change.

- An increase of $500,000 in the Special Projects Program will be used to support increased opportunities for training through the Research Experiences for Undergraduates program, Research Training Groups, and the field stations and marine laboratories program.

Number of People Involved in BIR Activities

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Senior Researchers	170	180	190
Other Professionals	160	170	180
Post-Doctorates	100	110	120
Graduate Students	200	220	230
Undergraduate Students	140	160	170
Total Number of People	770	840	890

COMPUTER AND INFORMATION SCIENCE AND ENGINEERING $273,500,000

The FY 1995 Budget Request for the Computer and Information Sciences and Engineering (CISE) Activity is $273.50 million, an increase of $32.92 million, or 13.7 percent, over the FY 1994 Current Plan of $240.58 million.

(Millions of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Change Amount	Change Percent
Computer and Computation Research	34.78	37.66	41.91	4.25	11.3%
Information, Robotics and Intelligent Systems	26.98	29.83	34.73	4.90	16.4%
Microelectronic Information Processing Systems	21.59	23.78	27.58	3.80	16.0%
Advanced Scientific Computing	70.01	74.86	85.17	10.31	13.8%
Networking & Communications Research & Infrastructure	39.90	51.46	58.26	6.80	13.2%
Cross-Disciplinary Activities	22.34	22.99	25.85	2.86	12.4%
Total, CISE	$215.60	$240.58	$273.50	$32.92	13.7%

Focused on computing, information processing and communications research, technology and products, the Computer and Information Science and Engineering Activity's programs span the spectrum of theoretical research, engineering design and development, prototyping and testing, deployment and using the technologies created to solve problems. CISE leads the Foundation's participation in the federal interagency **High Performance Computing and Communications** (HPCC) initiative. It also provides information-intensive knowledge for the **Advanced Manufacturing Technology** (AMT), **Advanced Materials Processing** (AMP) and **Biotechnology** programs, takes part in the **Science, Mathematics, Engineering and Technology Education** (SMETE) initiative, and stimulates research on a broad range of Grand Challenge Applications problems and national information infrastructure applications.

To meet its responsibilities, CISE uses several modes of support -- research projects, centers, facilities, and education and training.

- Research programs cover disciplinary areas such as those related to hardware, software, computer architectures, advanced communications, information and knowledge processing, and encouraging interdisciplinary work to solve scientific and national problems requiring the most advanced technologies available.
- Facilities include the NSFNET -- the major information backbone for the entire US. scientific community, and NSF Supercompter Centers that provide state-of-the-art computing capabilities for work in all fields of science and engineering, experiment with and develop high performance computers and tools, provide training and education in the use of the new scientific computing and information technologies, and encourage cross-sector collaboration.
- Centers work on complex interdisciplinary problems emphasizing knowledge transfer, linkages with private sector organization, and significant education and outreach.
- Education and training activities, ranging from the undergraduate through postdoctoral levels, include Research Experiences for Undergraduates, efforts to increase representation of women and minorities, and state-of-the-art training in computing and information technologies.

Research in Strategic Areas

Examples of research in strategic areas include:

(Millions of Dollars)

	FY 1994 Estimate	FY 1995 Estimate	Percent Change
Advanced Manufacturing Technology	21.90	21.90	0.0%
Biotechnology	20.50	20.50	0.0%
High Performance Computing and Communications	214.37	247.28	15.4%
Advanced Materials and Processing Program	19.00	19.00	0.0%
Science, Math, Engineering and Technology Education	10.02	10.02	0.0%

Note: Projects which have strong connections to the goals and objectives of more than one initiative are difficult to attribute to single initiative. In an effort to present a more precise measure of its research and education initiatives, NSF will redefine its internal data collection and analysis capabilities so that the allocation of resources for these initiatives can be shown in a mutually exclusive manner.

The FY 1995 Budget Request includes:

- **High Performance Computing and Communications (HPCC)** is distributed across the initiative's five components, including the recently added component for **Information Infrastructure Technology and Applications (IITA)**. CISE programs provide the core of the Foundation's involvement in this coordinated interagency program. Ongoing activities, supported through all subactivities within CISE, include research in such areas as high performance parallel computing; scientific and educational networking; grand challenge applications; digital libraries; infrastructure building; and human resource development.

  In FY 1995, HPCC in CISE will be supported at a level of $247.28 million, including $21.82 million for the IITA program component Activities across the original four program components will be interlaced across program elements, and will expand the IITA effort. Included is $10.58 million for continued support of four Science and Technology Centers, $122.53 million for supercomputer centers and networking, $120.03 million for research projects, and $20.35 million for education and training.

  CISE, through **NSFNET**, provides interagency leadership for the **National Research and Education Network (NREN $^{(sm)}$)** part of HPCC. CISE will continue to emphasize networking and its applications in FY 1995. Specifically, transition to the very high speed Backbone Network Service (vBNS) will be completed and very high speed links will be added to sites having very high speed requirements. This new nation-wide architecture will support high performance computing and national challenge application problems. In addition, the power of and access to high performance computing services will be enhanced by increasing the number of processors on scalable parallel systems and software activities at the NSF Supercomputer Centers, and expanding Metacenter and Regional Affiliates activities. Additional entry level scalable parallel systems will be provided to universities, new Computational Science Grand Challenge Application groups will be supported; and algorithm and software development for scalable parallel computing systems will be continued.

  Support for the **National Information Infrastructure** initiative will expand under the IITA component of the HPCC Program. IITA activities encompass information infrastructure services, system development tools and support environments, intelligent interfaces, and National Challenge Applications Problems. The FY 1995 program includes a Digital Libraries initiative (jointly sponsored with ARPA and NASA), remote access to large-scale scientific instrumentation, network connections, and research projects targeted at integrating advanced computing and communications systems into National Challenge applications The latter are information-intensive applications that have broad and direct impact on the nation's social and economic well-being and competitiveness. IITA activities draw and build on the work and cross-sector relationships developed in all HPCC component areas. They are in such areas as advanced manufacturing, government information dissemination, civil infrastructure, education and training and health care delivery. An infrastructure program to expand and broaden research capabilities to work on National Challenge applications will be initiated.

Other initiatives include:

- **Advanced Manufacturing Technology (AMT)** research totals $21.90 million in FY 1995. Ongoing projects include manufacturing related work focusing on advanced computer and information technologies to enable distributed design and intelligent distributed manufacturing of products, and systems-level issues in understanding, modeling and integrating hardware/software manufacturing technologies. While FY 1995 funding for AMT is not increased, additional funding for related information-intensive manufacturing research will be funded within IITA National Challenges, with special attention given to virtual prototyping, virtual reality, and applications of computational geometry.

- **Science, Mathematics, Engineering and Technology Education (SMETE)** support totals $10.02 million in FY 1995 for such activities as the Superquest program, Research Experiences for Undergraduates, undergraduate course and curriculum development, minority undergraduate activities, and networking for undergraduate institutions. Special efforts are directed towards precollege education, undergraduate education.

- Funding for the **Biotechnology and Advanced Materials Processing Program (AMPP)** totals $20.50 and $19.00 million respectively in FY 1995, unchanged from FY 1994.

Modes of Support

The CISE budget may also be examined in terms of the modes of support.

(Millions of Dollars)

	FY 1994 Estimate	FY 1995 Estimate	Percent Change
Research Projects	101.22	120.03	18.6%
Centers	9.78	10.58	8.2%
Facilities	109.23	122.54	12.2%
Education & Training	20.35	20.35	0.0%
Total, CISE	$240.58	$273.50	13.7%

Research Projects

Typically, about 42% of CISE funding is directed to understanding-driven research projects that cover all disciplinary areas for which CISE is responsible and simultaneously contributes to the initiatives in strategic areas. The work, carried out at colleges and universities, encompasses disciplinary research and cross-disciplinary cooperative projects, such as those carried out by Grand Challenge Application groups that involve computer and information specialists together with experts in other fields. CISE makes more than 1,700 awards each year having an average duration of 3.1 years and annualized funding level of about $80,000. Grants include necessary support for senior scientists, postdoctoral scientists, graduate students, and undergraduates.

Examples of research projects include:

- Machine translation has the potential of vastly improving, by orders of magnitude, the way people communicate with machines and among themselves. At present, language barriers limit the ability to assimilate and disseminate information across cultural lines and slow the growth of global economic activities. The JANUS system represents a step in reducing these. JANUS, an on-line machine speech-to-speech translation system developed by Dr. Waibel and co-workers at Carnegie Mellon University, was recently demonstrated in conjunction with sites in Germany and Japan. The system allows people speaking one language, such as English, to teleconference with a distant colleague speaking another (say German). JANUS accepts the speech in English, then with a combination of voice recognition, machine translation and speech synthesis, translates it into a synthesized sound message understandable by the German listener. Further development of experimental technologies such as this is critical to the creation of the user interfaces required for a successful national information infrastructure.

- Drs. Singh and Chi at the University of North Carolina have built BioScan, a protein sequence search engine. By using the underlying ideas of RISC architecture, putting only the common cases in hardware, and allowing the software to handle the rare cases, BioScan provides significant speedups and cost reductions in sequence searching when compared with conventional technology. Demand for BioScan processing by the research community has been extraordinarily high. A prototype using databases at the National Library of Medicine and connected to the Internet in fall 1993, processed 300 requests for searches over a two month period. To meet such needs and explore the benefits and limitations of this approach to device design, an effort to explore and extend the technology will be supported jointly by CISE and the Biological Sciences Activity.

- Because of their growing use in critical areas such as health care and banking, the security and reliability of large software systems has become increasingly important. Dr. Fred Schneider, of Cornell University, carried out fundamental research in formal methods for the design and analysis of fault-tolerant, real-time, distributed systems. The results of his work were applied in the national Air Traffic Control system in the form of the hand-off protocol used to transfer ownership from one air-traffic controller to another.

Centers

(Millions of Dollars)

	FY 1994 Estimate	FY 1995 Estimate	Percent Change
Science and Technology Centers	$9.78	$10.58	8.2%
Number of Researchers	80	90	12.5%
Number of Students	40	50	25.0%

CISE supports four Science and Technology Centers

- Center for Research in Parallel Computation (CRPC) (Rice University, California Institute of Technology, Syracuse University, University of Tennessee, Argonne National Laboratory, Los Alamos National Laboratory),
- Center for Discrete Mathematics and Theoretical Computer Science (Rutgers University, Princeton University, Bellcore, and Bell Laboratories),
- Center for Computer Graphics and Scientific Visualization (University of Utah, Cornell University, Brown University, California Institute of Technology, University of North Carolina), and
- Center for Cognitive Science (University of Pennsylvania).

These centers share several important characteristics: a unifying cross-disciplinary intellectual focus; an emphasis on knowledge-transfer and linkages with private sector organizations; and significant education and outreach components.

The following are examples of some centers' accomplishments.

- The recent release of Version 1 of High Performance Fortran illustrates the benefits realized from cooperative fundamental research in a center environment. One goal of the CRPC was to make massively parallel computer systems as usable as conventional supercomputers. A major barrier to the use of emerging parallel systems is a need to use programs already written in the widely used FORTRAN programming language, without rewriting existing code. With this in mind, the High Performance Fortran Forum, a coalition of academic, government and industrial groups led by CRPC, held a series of meetings involving vendors (such as CRAY and Digital Research), Fortran users, and computer scientists representing many countries. From these, there emerged a common parallel-Fortran language that can serve as a programming interface with new machines appearing on the market, ranging from clusters of workstations to massively parallel supercomputers.

- The Center for Cognitive Science, jointly supported with the Social, Behavioral and Economic Sciences Activity, provides extensive and unique educational experiences in this complex, interdisciplinary area. In addition to its active research program, the Center has begun a cooperative effort to develop a cognitive science curriculum at eight historically black colleges. This complements PENNlincs, a community outreach program that works with elementary schools in the Philadelphia area to develop elementary and first grade science education materials.

- Joint efforts between the Cornell and Stanford medical schools and the Graphics and Visualization Center have, for the first time, allowed physicians to view the beating heart cycle and valve action within the aortic chamber. The data used in producing the time-varying cardiac visualizations has thus far been limited by the use of external hand-held ultrasound transducers on the rib cage. To meet needs for increased sensitivity and understanding, it is planned to extend the volumetric rendering methods to combine intravascularly - obtained data with stereoangiography.

Facilities

(Millions of Dollars)

	FY 1994 Estimate	FY 1995 Estimate	Percent Change
Supercomputer Centers	68.07	76.38	12.2%
NSFNET	41.16	46.16	12.1%
Total Facilities Support, CISE	$109.23	$122.54	12.2%
Number of Researchers	160	180	12.5%
Number of Students	260	260	0.0%

CISE supports user facilities necessary for the conduct of research and education including NSFNET and the four national supercomputer centers. NSF support provides for ongoing operations and maintenance, including upgrades to existing facilities, access to the external science and education communities, and experimentation with and development of advanced technologies.

- Support for NSFNET will increase $5.00 million in FY 1995 to $46.16 million to provide for final transition activities from the old NSFNET architecture to the very high-speed Backbone Network Service (vBNS).

  More than 1,200 US colleges and universities are now fully connected to the Internet. Traffic carried by the NSFNET Backbone Service in December 1993 was 8.3 terabytes, almost double that carried in December 1992. To increase access to the rapid growth in computing power, the NSFNET, during

1994, will be moving to a new architecture in which regional networks acquire commodity-level services directly from private sector networking companies, while high-speed quasi-experimental services are provided by a new very-high-speed Backbone Network Service (vBNS).

- Originally established in 1986 the four Supercomputer Centers continue to supply access to state-of-the-art computing resources not available elsewhere to over 8,000 users in all science and engineering disciplines supported by NSF. Their scope has expanded to include partnerships permitting private sector organizations to experiment with the application of high performance computing technologies, broadening the base of scientists and others exposed to high performance computing; and early deployment, testing, and evaluation of new products from a wide range of hardware, software and computer systems vendors.

The following statistics for FY 1992 suggest the Centers' impact and success.

Number of Users (high school, undergraduate, graduate, faculty researchers)	>8,000
Resulting Papers	>1,000
Workshop and Training Attendees	>4,000
Affiliated Universities (44 states. DC, Puerto Rico)	>200
Non-academic partners	>100
Number of Center-developed software downloads	>90,000
Fraction of non-NSF support (universities, state governments, industry, other agencies)	>50%

Highlights from the past year include:

Researchers at the San Diego Center received the 1993 *Forefront in Computing Award* for determining the structure of a protein kinase essential for the function of hormones such as adrenaline. Knowledge of such structures facilitates the design of drugs capable of addressing protein kinase-related diseases, such as diabetes, leukemia, and breast cancer.

Working with National Center for Supercomputing Applications, Schlumberger Inc., developed a seismic application program that achieves over 50% of the peak speed of a new parallel system and reduces computation time from weeks to days on certain classes of problems.

Education and Training

(Millions of Dollars)

	FY 1994 Estimate	FY 1995 Estimate	Percent Change
K-12	0.50	0.50	0.0%
Undergraduate	8.32	8.32	0.0%
Graduate	0.00	0.00	0.0%
Post-Doctoral	1.20	1.20	0.0%
Other	10.33	10.33	0.0%
Total Education & Training, CISE	20.35	20.35	0.0%

CISE incorporates programs for education and training in order to maintain the future supply of scientists and engineers in all of its strategic responsibilities, to increase the participation of underrepresented groups, to experiment with innovative applications of computer, communications and information technology, and to provide training in state-of-the-art computing and computation. It supplements participation in Foundation-wide activities such as Research Experiences for Undergraduates (REU), and Research in Undergraduate Institutions (RUI) with activities more specific to CISE fields.

Activities include:

- In recognition of the need for more people with advanced skills in all areas of computer and information science and engineering, efforts are being made to incorporate recent research findings into the undergraduate curriculum. The goal is to improve the education of undergraduates in information technology so that they are well-prepared for careers in research, teaching or industry.

- Responding to the low level of participation of underrepresented groups in CISE disciplines, a program was developed to enable colleges and universities with large enrollments of such groups to obtain the instrumentation needed, or engage in activities to increase interest in computer and information related careers. The University of Texas at El Paso has an outreach program targeted at Hispanic grade and high schools. A somewhat different approach is being followed by the City University of New York with its program to increase retention through peer tutoring and intensive mentoring by Hispanic and African-American students.

  Along another dimension, CISE initiated a series of activities to expand opportunities for women to pursue careers in its disciplines. These include a workshop attended by over 120 female junior faculty and graduate students discussing the requirements for success in an academic career; a symposium, "Windows of Opportunity" for 200 undergraduate and graduate women in which senior women scientists described why they chose to enter and stay in the computing sciences; and graduate fellowships for women in CISE disciplines.

- Computational science has taken on increasing importance in the past few years. Two activities -- Superquest and Postdoctoral Research Associates -- span the entire range of educational levels. The former, directed at high school students is structured as a competition in which highly talented students solve real problems on supercomputers. The latter provides advanced training in high performance computing techniques and technology to permit attacking significant, computationally-demanding problems.

Number of People Involved in CISE Activities

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Senior Researchers	1,390	1,550	1,760
Other Professionals	0	0	0
Post-Doctorates	240	260	290
Graduate Students	1,540	1,700	1,940
Undergraduate Students	360	400	430
K-12 Teachers	40	40	40
K-12 Students	60	60	60
Total Number of People	3,630	4,010	4,520

CISE Funding Profile

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Total Number of Awards	1,394	1,523	1,720
Statistics for Competitive Awards:			
Number	680	730	780
Funding Rate	31%	30%	30%
Median Annualized Award Size	$52,279	$52,500	$52,600
Average Annualized Award Size	$80,535	$82,100	$83,500
Average Duration (yrs.) \1	3.1	3.1	3.1

1\ Average Duration includes research projects only.

COMPUTER AND COMPUTATION RESEARCH $41,910,000

The FY 1995 Budget Request for the Computer and Computation Research (CCR) Subactivity is $41.91 million, an increase of $4.25 million, or 11.3 percent, over the FY 1994 Current Plan of $37.66 million.

(Millions of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Changes Amount	Changes Percent
Theory of Computing	8.54	9.09	10.15	1.06	11.7%
Numeric, Symbolic and Geometric Computation	6.07	7.01	7.72	0.71	10.1%
Computer Systems	3.88	4.12	4.50	0.38	9.2%
System Software	11.96	12.68	14.00	1.32	10.4%
Software Engineering	4.33	4.76	5.54	0.78	16.4%
Total, CCR	$34.78	$37.66	$41.91	$4.25	11.3%

The Computer and Computation Research Subactivity contributes to the fundamental understanding of the theory of computation, alternative architectures for computer systems, and the methodology of and tools for designing software. Ongoing programs support research in such areas as fundamental theory underlying the development of better algorithms for selected applications, numerical solutions of science and engineering applications, problems in creating, maintaining, and managing real time systems, programming languages for high performance computing, computer security, and computational geometry. This Subactivity is a major source of funding for basic research in these fields. By focusing its basic research priorities, CCR plays an important role in several interagency programs, such as **High Performance Computing and Communications** (HPCC).

The FY 1995 budget request includes participation by all program elements:

- Ongoing research in CCR , totaling $37.66 million, includes $30.64 million for **High Performance Computing and Communications** (HPCC) including **Information Infrastructure Technology and Applications** (IITA). Activities include basic research on heterogeneous parallel and distributed computation -- architectures that are key technologies for future advances in high performance computing.

- An increase of $4.25 million in FY 1995 will bring the total for HPCC (with IITA) to $34.89 million. Of this, $3.00 million will increase research in problems solving environments for high performance computing and the application of the theory of algorithms to other science and engineering disciplines. Also included is research aimed at techniques for reducing the cost of software development, tools for grand challenge applications, and new technologies to make using computers less costly and less error prone.

- Within the $4.25 million, the IITA component of HPCC will increase $1.25 million, for additional research on reliable computer controlled systems, such as flight control systems, and the application of computer science research to manufacturing, with special attention on the application of geometric modeling. Funding will be increased for the S&T centers by $350,000.

Number of People Involved in CCR Activities

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Senior Researchers	410	450	500
Other Professionals	0	0	0
Post-Doctorates	30	30	30
Graduate Students	410	450	500
Undergraduate Students	40	50	50
K-12 Teachers	0	0	0
K-12 Students	0	0	0
Total Number of People	890	980	1,080

INFORMATION, ROBOTICS AND INTELLIGENT SYSTEMS $34,730,000

The FY 1995 Budget Request for the Information, Robotics and Intelligent Systems (IRIS) Subactivity is $34.73 million, an increase of $4.90 million, or 16.4 percent, over the FY 1994 Current Plan of $29.83 million.

(Millions of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Change	
				Amount	Percent
Knowledge and Database Systems	11.89	13.13	14.78	1.65	12.6%
Robotics and Machine Intelligence	6.29	7.10	8.35	1.25	17.6%
Interactive Systems	4.67	4.80	5.90	1.10	22.9%
Information Technology and Organizations	4.13	4.80	5.70	0.90	18.8%
Total, IRIS	$26.98	$29.83	$34.73	$4.90	16.4%

The Information, Robotics, and Intelligent Systems (IRIS) Subactivity supports research to enable the rapidly emerging information society. The principal goals are to improve basic understanding and design of information and knowledge processing mechanisms; to facilitate information and knowledge exchange between humans and machines; and to understand better the impact of advanced information technologies in distributed work environments. This Subactivity is a major source for academic research in these fields. By focusing its basic research priorities, IRIS plays an important role in several interagency programs, especially in the new **Information Infrastructure Technology and Applications** (IITA) component of the **High Performance Computing and Communications** (HPCC) program.

Ongoing programs support research in such areas as the design of database and knowledge-based systems, information systems in distributed and networked environments, virtual reality and multimedia environments, human language technology, and sensor-based control in intelligent robots. One Science and Technology Center, co-funded with the Social, Behavioral and Economic Sciences Activity, deals specifically with interdisciplinary research involving information and cognitive science.

The FY 1995 budget request includes:

- Ongoing research in support of the HPCC program, including IITA, totals $16.47 million across the Subactivity.

- Ongoing research under the IITA component totals $1.98 million. It focuses on the underlying science and the development of technology and prototypes to speed the realization of distributed electronic knowledge networks and the national information infrastructure. In FY 1995, within the IITA increase of $3.85, $1.00 million will be added to significantly involve 20-25 smaller institutions in six planned core projects. The remainder will extend research on virtual prototyping for advanced manufacturing and add support for national challenges in government information systems, civil infrastructure and health care. This will require attention in areas such as heterogeneous databases, knowledge systems, intelligent automation, and interactive use of sensor, displays and effectors.

- In FY 1995, an additional $1.05 million will be distributed across all program elements to increase intelligent systems research, and Grand Challenge Applications. One goal is to encourage scale-up experiments and connect research more closely with real applications.

- Ongoing activities in Advanced Manufacturing Technology include research on information access, knowledge bases, intelligent automation, and human-computer interfaces in design and production.

Number of People Involved in IRIS Activities

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Senior Researchers	440	480	560
Other Professionals	0	0	0
Post-Doctorates	40	40	50
Graduate Students	450	500	570
Undergraduate Students	40	40	50
K-12 Teachers	0	0	0
K-12 Students	0	0	0
Total Number of People	970	1060	1230

MICROELECTRONIC INFORMATION PROCESSING SYSTEMS $27,580,000

The FY 1995 Budget Request for the Microelectronics Information Processing Systems Subactivity is $27.58 million, an increase of $3.80 million, or 16.0 percent, over the FY 1994 Current Plan of $23.78 million.

(Millions of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Change Amount	Change Percent
Design, Tools and Test	4.16	4.44	5.14	0.70	15.8%
Microelectronic Systems Architecture	3.87	4.17	4.77	0.60	14.4%
Circuits and Signal Processing	4.18	4.45	4.95	0.50	11.2%
Experimental Systems	7.08	7.82	9.12	1.30	16.6%
Systems Prototyping and Fabrication	2.30	2.90	3.60	0.70	24.1%
Total, MIPS	$21.59	$23.78	$27.58	$3.80	16.0%

The Microelectronic Information Processing Systems Subactivity (MIPS) supports research on computing and information processing systems including signal processing. Its focus is on experimental research; environments and services for rapid prototyping of systems, design methodologies and tools, technology-driven and application-driven computer systems, and algorithms and architectures for signal processing. Because of its focus on managing design complexity and creating new functional capabilities, MIPS plays a significant part in the **High Performance Computing and Communications**(HPCC) and **Advanced Manufacturing Technology** (AMT) programs. It closely collaborates with other NSF activities and other federal agencies, such as ARPA.

Ongoing programs support research in such areas as theoretical foundation of integrated circuit (IC) chip and system design, rapid system prototyping for experimentation and manufacturing, new packaging and interconnect technologies, fundamental aspects of computing system architectures and design methods, and multi-dimensional and very large scale integration (vlsi) signal processing.

The FY 1995 budget request includes:

- Ongoing programs focus research in areas such as high performance application-specific-computing-systems, and tools and CAD frameworks for design, analysis and realization.

  An increase of $2.00 million in FY 1995 involving the Design, Tools and Test; Experimental Systems; Systems Prototyping and Fabrication; and Microelectronic Systems Architecture, will increase research in advanced memory hierarchies, intelligent I/O, and system level tools for experimental science research and education.

- Ongoing research in support of IITA totals $1.09 million, including research on rapid systems prototyping and text searching computing engines for use in accessing digital libraries. An increase of $1.80 million in FY 1995, distributed over Experimental Systems; Design, Tools, and Test; Microelectronic Systems Architecture; and, Systems Prototyping and Fabrication giving a total of $2.89 million, will support additional research in virtual prototyping and manufacturing, and in digital libraries involving research on mass storage techniques and low power portable text searching and computing systems.

- Ongoing research in support in the Advanced Manufacturing Technology initiative, involving all MIPS program elements, totals $7.5 million. It includes high performance application specific computing systems; new enabling technologies for distributed design and manufacturing; cad tools; and models of artifacts and manufacturing processes. Additional work on information-intensive manufacturing is supported through projects funded through the IITA increment.

Number of People Involved in MIPS Activities

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Senior Researchers	200	220	250
Other Professionals	0	0	0
Post-Doctorates	10	10	10
Graduate Students	270	300	350
Undergraduate Students	10	10	10
K-12 Teachers	0	0	0
K-12 Students	0	0	0
Total Number of People	490	540	620

ADVANCED SCIENTIFIC COMPUTING $85,170,000

The FY 1995 Budget Request for the Advanced Scientific Computing Subactivity is $85.17 million, an increase of $10.31 million, or 13.8 percent, over the FY 1994 Current Plan of $74.86 million.

(Millions of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Change Amount	Change Percent
Supercomputer Centers	65.91	69.86	78.47	8.61	12.3%
New Technologies	4.10	5.00	6.70	1.70	34.0%
Total, ASC	$70.01	$74.86	$85.17	$10.31	13.8%

The Advanced Scientific Computing Subactivity (ASC) supports advanced research on the development, use and application of state-of-the-art high performance computing hardware and software systems. It provides the U.S. academic research community with access to state-of-the-art supercomputers, both vector and parallel, provides training on systems at all levels of the educational range, works closely with industry on the development and use of these systems, and plays a key role in the **High Performance Computing and Communications** (HPCC) program.

The four NSF Supercomputer Centers are:

- Cornell National Supercomputer Facility at Cornell University;
- National Center for Supercomputing Applications at the University of Illinois;
- Pittsburgh Supercomputing Center; at Carnegie Mellon University, University of Pittsburgh, and Westinghouse; and
- San Diego Supercomputer Center at the University of California at San Diego

These centers serve the computational needs of all NSF science and engineering disciplines. Additional activities at the Centers include information on and access to emerging technologies; software tools for high performance computing; core functions of the Metacenter; support for Grand Challenge applications; and education, training, and outreach at all levels. The Centers have pioneered partnerships with the private sector working to introduce high performance computing technologies into national industries to solve design and manufacturing problems, and are involved in testing the next generation of capabilities.

Laying the basis for future high performance computation, the New Technologies Program supports research such as development of software to support new parallel systems, and techniques for performance assessment. A Science and Technology Center, which has strong commitment from and involvement with industry, advances computer graphics and scientific visualization .

The FY 1995 budget request includes:

An increase of $8.61 million in FY 1995 for a total of $78.17 million will continue enhancing the Centers' computing technology, facilitate application of this technology, and broaden access to it by providing:

- $4.30 million for support of new systems/upgrades of current systems at the Supercomputer Centers.

- $2.00 million to enhance metacenter activities, with emphasis on enabling a national file system, and connection to the very high speed Backbone Network Service (vBNS).
- $2.00 million additional for Regional Affiliates, to enhance local and regional scale computing and communications expertise of a wide variety of institutions and individuals in the university, that are affiliated with the expanding Metacenter activities of the NSF Supercomputer Centers.
- Science and Technology Center activities will be augmented by $300,000.

A total increase of $1.70 million will increase cross-disciplinary research related to Grand Challenge Applications and National Challenges. In particular,

- $1.00 million will be added for National Challenges in the Information Infrastructure Technology and Applications Program, with emphasis on Health Care and Education.
- $700,000 will be added for additional computational science and engineering Grand Challenge Applications Groups.

Number of People Involved in ASC Activities

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Senior Researchers	80	90	100
Other Professionals	0	0	0
Post-Doctorates	100	110	130
Graduate Students	150	150	170
Undergraduate Students	170	200	200
K-12 Teachers	40	40	40
K-12 Students	60	60	60
Total Number of People	600	650	700

NETWORKING AND COMMUNICATIONS RESEARCH AND INFRASTRUCTURE $58,260,000

The FY 1995 Budget Request for the Networking and Communications Research and Infrastructure Subactivity is $58.26 million, an increase of $6.80 million, or 13.2 percent, over the FY 1994 Current Plan of $51.46 million.

(Millions of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Change Amount	Change Percent
NSFNET	30.10	41.16	46.66	5.50	13.4%
Networking and Communications Research	9.80	10.30	11.60	1.30	12.6%
Total, NCRI	$39.90	$51.46	$58.26	$6.80	13.2%

The Networking and Communications Research and Infrastructure Subactivity (NCRI) is responsible for development and operation of NSFNET, coordinating the National Research and Education Network (NREN$^{(sm)}$) part of the **High Performance Computing and Communications** program, and for fundamental research on communications theory and data networks. NCRI is involved in extensive collaborative development of national and international networks with other agencies. It leads the federal implementation of the NREN$^{(sm)}$ program, and has managed the explosive and successful growth of the national infrastructure providing access to information and computing resources to academic and industrial organizations in all states. Fundamental research, both disciplinary and interdisciplinary, is supported in such areas as coding, network security and survivability, lightwave network architectures, protocol theory, and dynamic network control to lay the groundwork for future developments. Facilities supported by the Networking and Communications Research and Infrastructure Subactivity include the NSFNET/Internet.

The FY 1995 Budget Request builds on activities in support of **High Performance Computing and Communications** (HPCC), including IITA for a total $50.96 million in FY 1994.

- Ongoing activities enable NSFNET to provide for final transition activities to the new NSFNET architecture. It includes operation of Network Access Points (NAPs), the Routing Arbiter (RA), provision for inter-regional connectivity, the very high speed Backbone Network Service (vBNS), Internet Registration, Information, and Directory services, and continued interagency participation in shared Internet infrastructure. An increase of $5.00 million in FY 1995, will increase inter-regional connectivity and upgrade regional infrastructure to provide for bandwidth-intensive scientific/engineering applications.

- Smaller colleges and universities, as well as pre-college institutions, will continue to be connected into the NSFNET. Collaboration with the National Library of Medicine to connect medical campuses and public health facilities will be maintained, along with other interagency partnerships. Basic research in networking and communications, including a collaborative effort with the Engineering Activity in all-optical networks, will increase $1.30 million in FY 1995 to further emphasize fundamental research on the basic theory of extremely high speed networks

- In FY 1995, $500,000, within the IITA component will provide additional support for network-intensive National Challenges applications.

Number of People Involved in NCRI Activities:

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Senior Researchers	160	210	240
Other Professionals	0	0	0
Post-Doctorates	<10	<10	<10
Graduate Students	170	210	240
Undergraduate Students	50	50	60
K-12 Teachers	0	0	0
K-12 Students	0	0	0
Total Number of People	380	470	540

CROSS-DISCIPLINARY ACTIVITIES $25,850,000

The FY 1995 Budget Request for the Cross Disciplinary Activities Subactivity is $25.85 million, an increase of $2.86 million, or 12.4 percent, over the FY 1994 Current Plan of $22.99 million.

(Millions of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Change Amount	Change Percent
CISE Institutional Infrastructure	18.83	19.43	21.89	2.46	12.7%
CISE Instrumentation	3.51	3.56	3.96	0.40	11.2%
Total, CDA	$22.34	$22.99	$25.85	$2.86	12.4%

The Cross-Disciplinary Activities Subactivity (CDA) is responsible for improving the long-term research equipment and human resource infrastructure of the CISE fields. It builds essential shared research instrumentation infrastructure within academic institutions and improves and expands education and human resources through infrastructure development. CDA collaborates on education and human resource matters within the **High Performance Computing and Communications** (HPCC) program and plays an important role in several interagency programs by focusing its infrastructure building priorities on critical aspects of them.

Ongoing programs support innovative educational activities in CISE disciplines, development of instructional software and technologies, improvement of experimental research capabilities, special purpose equipment, and a variety of activities to expand opportunities for underrepresented groups in computer and information science and engineering.

The FY 1995 budget request includes:

- Ongoing activities in CISE Institutional Infrastructure include research infrastructure, incorporation of research into the undergraduate curriculum, infrastructure development at colleges and universities with high enrollments of underrepresented groups, and postdoctoral associates in CISE experimental science. Ongoing activities in Instrumentation include support for shared instrumentation facilities and matching support for workstation and other individual research equipment items. Significant infrastructure support has been provided for scalable parallel computers, high speed networks, and human/computer interface equipment supporting CISE research in computational science and engineering

  An increase of $2.46 million in CISE Institutional Infrastructure will focus on new infrastructure to enable research on national challenges and ongoing educational and minority activities related to the **Information Infrastructure Technology and Applications** (IITA) component of the **High Performance Computing and Communications** initiative. This includes an increase of $1.90 million for new support for infrastructure for the IITA component of HPCC, and $560,000 additional for efforts to raise the low level of participation of under-represented groups in CISE disciplines.

- The CISE Instrumentation program supports both the acquisition of shared research equipment not generally available on individual project awards and helps support equipment necessary for individual researchers. This activity will be increased by $400,000 in FY 1995.

Number of People Involved in CDA Activities:

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Senior Researchers	100	100	110
Other Professionals	0	0	0
Post-Doctorates	60	70	70
Graduate Students	90	90	110
Undergraduate Students	50	50	60
K-12 Teachers	0	0	0
K-12 Students	0	0	0
Total Number of People	300	310	350

ENGINEERING $320,410,000

The FY 1995 Budget Request for Engineering is $320.41 million, an increase of $25.24 million, or 8.6 percent, over the FY 1994 Current Plan of $295.17 million.

(Millions of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Change Amount	Change Percent
Bioengineering & Environmental Systems	20.42	22.13	23.53	1.40	6.3%
Chemical & Transport Systems	34.47	37.07	38.37	1.30	3.5%
Design, Manufacture, & Industrial Innovation	46.20	66.60	79.86	13.26	19.9%
Electrical & Communications Systems	34.12	36.97	39.35	2.38	6.4%
Engineering Education & Centers	81.04	88.68	92.68	4.00	4.5%
Civil & Mechanical Systems	39.80	43.72	46.62	2.90	6.6%
Total, ENG	$256.05	$295.17	$320.41	$25.24	8.6%

The Engineering Activity (ENG) seeks to enhance long-term economic strength, security, and quality of life for the nation by fostering innovation, creativity, and excellence in engineering education and research. ENG's strategy is to promote the natural synergy between engineering education, fundamental research, and the application of technical knowledge. ENG increasingly seeks to focus and integrate education and research in interdisciplinary areas such as design and manufacturing, information and communications technologies, environmental research, and biotechnology These efforts will develop the creative people and new fundamental knowledge required to meet the challenges of the 21st century, such as revitalizing the nation's deteriorating civil infrastructure and developing the advanced manufacturing and processing methods needed to strengthen the competitive position of U.S. industry

To amplify its efforts, ENG focuses on creating dynamic new partnerships among industry, academe, other federal agencies, state and local governments, professional societies, and foreign countries. For example, ENG's Earthquake Hazard Mitigation Program is part of the federal interagency National Earthquake Hazards Reduction Program (NEHRP). ENG's role in this multi-agency partnership includes supporting research on buildings, infrastructure, and post-earthquake studies.

ENG maintains a strong interface with industry through its Design, Manufacture, and Industrial Innovation Subactivity, and through programs such as Engineering Research Centers, Industry/University Cooperative Research Centers, Small Business Innovation Research, Management of Technological Innovation and Industry/University Liaison. Strengthening the connections between academe and industry increases the value and responsiveness of engineering education and fundamental research and helps accelerate the application of engineering discoveries and new technologies in the marketplace.

ENG's investment strategy is one of maintaining an appropriate balance among overlapping needs, such as: fundamental research in pursuit of new knowledge for its own sake and for its strategic importance to the nation; mature and emerging fields of research; and disciplinary and cross-disciplinary research. This balance is based on conscious policy and priorities developed through ENG's strategic planning process. Overall, NSF provides about 30 percent of the total Federal support for engineering research at U.S. universities and colleges.

Research in Strategic Areas

Examples of research in strategic areas include:

(Millions of Dollars)

	FY 1994 Estimate	FY 1995 Estimate	Percent Change
Advanced Manufacturing Technology	122.10	123.10	0.8%
Advanced Materials and Processing Program	67.70	67.70	0.0%
Biotechnology	26.60	26.60	0.0%
Civil Infrastructure Systems	37.00	39.00	5.4%
Environmental Research	26.75	28.25	5.6%
High Performance Computing & Communications	5.80	10.83	86.7%
Science, Math, Engineering & Technology Education	30.15	33.65	11.6%

Note. Projects which have strong connections to the goals and objectives of more than one initiative are difficult to attribute to single initiative. In an effort to present a more precise measure of its research and education initiatives, NSF will redefine its internal data collection and analysis capabilities so that the allocation of resources for these initiatives can be shown in a mutually exclusive manner.

Because education and research are closely tied to the application of knowledge to the pressing concerns of society, research in strategic areas of national priority has become an integral part of ENG's portfolio. Such initiatives are developed with extensive leadership and input from the science and engineering community at large, as well as from government agencies. They are designed to increase the potential for early application of recently discovered knowledge by promoting cooperation among academe, industry, and government at all levels. Furthermore, these initiatives devote significant attention to education and training, as well as research, through such activities as curriculum development and instrumentation support.

The FY 1995 budget request includes support for the following:

- $123.10 million, an increase of $1.00 million over FY 1994, for the **Advanced Manufacturing Technology** (AMT) initiative. Support for this effort remains one of ENG's highest priorities because of the potential for new engineering knowledge to accelerate the development of advanced technologies that can dramatically improve the way products are manufactured in the future. Ongoing activities include research on the development of intelligent (sensor-based) manufacturing cells/systems; advanced fabrication and processing methods; and integrated computer-based tools for product, process, and enterprise design. Support will continue for the Agile Manufacturing Initiative (AMI), which is supported through a partnership between NSF and the Advanced Research Projects Agency (ARPA). The AMI will facilitate and support university/industry/government teams to jointly articulate a national research agenda through an industry-led AMI Forum and will also support research in university-based Agile Manufacturing Research Institutes. In FY 1995, ENG's AMT effort has been broadened to include research in: (1) the advanced large-scale manufacturing/bioprocessing of substances of biological origin; and (2) the synthesis and processing of advanced materials needed to meet the manufacturing challenges of the next decade. Formerly, these research areas were included within the **Biotechnology** and **Advanced Materials and Processing Program** (AMPP) initiatives. These two initiatives continue to be supported at existing levels.

- $10.83 million, an increase of $5.03 million over FY 1994, to support ENG's effort in the **High Performance Computing and Communications** (HPCC) initiative. This very high priority effort includes:

- $5.30 million for the **Information Infrastructure Technology and Applications** (IITA) program, which seeks to develop the common services, systems development, and support environments for a national information infrastructure. Ongoing efforts, at a level of $1.80 million, are focused on: (1) Health Care Delivery Systems -- enabling technologies, advanced telecommunications, and networking technologies for distributed access in clinical diagnosis and treatment planning; (2) Advanced Manufacturing Technology -- pilot projects using information modeling, visualization, and distributed databases to demonstrate approaches to agile manufacturing; (3) Civil Infrastructure Systems -- distributed large-scale databases, libraries, and knowledge-based expert systems for assessment strategies and design methodologies; (4) Environmental Research -- integration of sensors, data, and communications systems for environmental monitoring and quality assessment; and (5) Engineering Education -- integration of telecommunications, computer, and multimedia technologies for new approaches to learning. The FY 1995 increase of $3.50 million will substantially expand the number of multidisciplinary research projects that can be supported by NSF.

- $5.53 million, an increase of $1.53 million over FY 1994, to expand current research efforts in: (1) optical communications systems research for all-optical networks, to provide high connectivity, multi-gigabit interconnects of remote processors; and (2) development of computational tools and algorithms applied to the solution of complex engineering problems, and for continued participation in the NSF Grand Challenge Application Group initiative.

- $28.25 million, an increase of $1.50 million, for **Environmental Research**. ENG's current research effort is focused on: (1) pollution remediation, in which waste is generated and disposed of; (2) pollution control, in which pollutants are neutralized before they enter the environment; and (3) pollution avoidance, in which the manufacturing process is designed to prevent or minimize the generation of waste at all stages of the product life cycle. The strategy is to develop generic technologies that will enable industry to move in the direction of pollution minimization and avoidance. The FY 1995 increase will expand research in the following areas: (1) improving existing and creating new preventive and remedial environmental technologies; (2) developing environmentally sound extraction/production systems where waste and contamination are prevented or minimized; and (3) engineering innovation in environmental sensors and control systems.

- $39.00 million, an increase of $2.00 million over FY 1994, for a multi-disciplinary, cross-directorate research initiative to develop new scientific and engineering knowledge needed to maintain, repair, and rebuild the nation's **Civil Infrastructure Systems**. The FY 1995 effort will continue and expand current efforts to develop and apply new knowledge in deterioration science, assessment technologies, renewal engineering, and institutional effectiveness and productivity. Such research efforts will lead to new designs, more durable materials, advanced construction automation and manufacturing methods, and improved decision-making and management processes. Included in this effort is research to develop rational assessment methods and cost-effective retrofit techniques to correct deficiencies in existing structures exposed to earthquake hazards.

- $33.65 million, an increase of $3.50 million, for the **Science, Mathematics, Engineering, and Technology Education** (SMETE) initiative. Activities are supported to reform the undergraduate curriculum, to explore innovative educational delivery systems, to integrate education and research to bring new developments to the curriculum, and to increase the involvement of women and underrepresented minorities in engineering.

Modes of Support

Another way of displaying the ENG budget is by modes of support. ENG supports its ongoing and new activities through the following modes:

(Millions of Dollars)

	FY 1994 Estimate	FY 1995 Estimate	Percent Change
Research Projects	168.73	190.47	12.9%
Centers	63.35	63.35	0.0%
Facilities	2.20	2.20	0.0%
Education & Training	60.89	64.39	5.7%
Total, ENG	$295.17	$320.41	8.6%

Research Projects

Almost 60 percent of ENG funding is used to provide grants to individuals and small groups of researchers. About 75 percent of this support is focused in areas that are of strategic importance, with the other 25 percent being focused on a broad array of fields that are important in maintaining the vitality and future capability of the engineering research community, such as surface engineering, solid mechanics, neuroengineering, fluid dynamics, and thermal systems. In recent years, the support provided for individual research projects has had a major impact on engineering education and research, reaching tens of thousands of university faculty and students. For example, ENG-supported research has:

- Played a key role in the development of microelectromechanical systems as a field of research. Advances made possible by NSF funding include: the first silicon electrostatic micro-motor, the first magnetic micro-motor, the first comb-structure resonant motors, the first scanning tunneling probes fabricated in silicon, and a variety of technologies for micro-mechanical devices, fluidic devices, and sensors.

- Helped establish the designs and building codes for present day earthquake resistant buildings. Focusing on the response of soils and structures to earthquake loads, research results have contributed to enhanced seismic safety in areas at risk throughout the country.

- Led to the development of new techniques for mathematical optimization and control that are now widely used by many industries. Industrial problems that could not even be approached a few years ago are now readily solvable.

- Developed electrokinetic soil processing as an emerging technology in hazardous waste remediation and treatment. Contaminants migrating from facilities, accidental spills, and industrial operations threatening the nation's health and ground-water supply have been successfully removed using electro-osmosis.

The FY 1995 budget request includes:

- The Small Business Innovation Research (SBIR) Program increasing by $11.11 million to a total of $42.31 million. Support for this Foundation-wide program is provided at the mandated level of at least 2.0 percent of extramural research, as required by the Small Business Research and Development Enhancement Act of 1992 (P.L. 102-564). The Program gives special emphasis in the selection of research awards to critical technology areas, such as novel materials, advanced manufacturing, high performance computing and communications, biotechnology, and education at all levels.

- The Small Business Technology Transfer (STTR) Program increasing by $1.00 million to a total of $2.40 million. Funding is provided at the mandated level of at least 0.1 percent of extramural research, as required by P.L. 102-564. This pilot project involves small technology intensive firms in exploiting a new reservoir of commercially promising ideas which originates in universities and other nonprofit research institutions. The emphasis is on the development of new and improved analytical and characterization instruments and sensors having application in chemistry, materials science, biotechnology, or environmental sciences.

Centers

ENG pioneered the use of university-based research centers to assemble multidisciplinary teams of individual investigators to collaborate on multidisciplinary research and systems-oriented issues.

(Millions of Dollars)

	FY 1994 Estimate	FY 1995 Estimate	Percent Change
Industry/University Cooperative Research Centers	4.50	4.50	0.0%
State Industry/University Cooperative Research Centers	3.35	3.35	0.0%
Engineering Research Centers	51.50	51.50	0.0%
Earthquake Center	4.00	4.00	0.0%
Total Center Support, ENG	$63.35	$63.35	0.0%
Number of Researchers	770	770	0.0%
Number of Students	1,825	1,825	0.0%

The FY 1995 budget request includes:

- A total of $51.50 million for the Engineering Research Centers (ERCs) to support a total of 22 centers. Between 1985 and 1990, 21 centers were established with ENG support, with 18 in operation at the beginning of FY 1994. During FY 1994, the program plans to add three or four new centers. NSF's annual funding of each ERC averages approximately $2.50 million, with a range of $1.30 to $3.00 million. Total funding from all sources, including industry, averaged about 2.5 times the NSF contribution. ERCs have enhanced a systems-oriented focus in academic education and research, and have served as a model for similar centers in the U.S. and worldwide. These centers have established close working relationships with industrial firms. In 1993, the 18 centers had over 600 industrial memberships, about a third of which were small businesses. Annual industrial cash support for the centers totals over $25 million, and about 120 engineers from industry spend time working in the centers. Over the past year, these centers have received 70 patents and have licensed over 200 patents and software products to industry.

- A total of $3.35 million, no change from FY 1994, for State Industry/University Cooperative Research Centers (I/UCRCs). Ongoing activities will provide funding for approximately thirteen State I/UCRCs. State I/UCRCs seek to enhance local and regional economic development, and actively focus on technology transfer and knowledge deployment. The support of these technology-focused centers is shared by NSF, state governments, and industry. Currently, 168 companies are working with over 600 faculty and students. These companies contribute $10.50 million to the centers, more than three times the funding provided by NSF. In 1992, ten patents were received by three centers, with three patent disclosures by one center alone. In 1993, thirteen patents were issued to five centers, and nine patent disclosures were filed.

- $4.50 million, the same level as in FY 1994, to support 55 "regular" Industry/University Cooperative Research Centers (I/UCRCs). NSF's annual support for these centers ranges between $50,000 and $100,000 and, on average, is leveraged 7 times with industrial support and 15 times with industry and other support combined. These centers involve about 1,800 faculty and students who work with over

600 firms across the nation. These I/UCRCs have spawned a wide range of changes in industrial processes and numerous advances that have resulted in commercially viable products and technologies. For example, the I/UCRC for Measurement and Manufacturing Control at the University of Michigan developed a dimensional measurement methodology which allowed Chrysler's Jeep Grand Cherokee Plant to improve the dimensional tolerance of the assembly of automobile body panels from 5 mm to 2 mm, a tolerance standard used by Toyota Motors. This improvement enables Chrysler to achieve a level of world-class quality in competing with foreign automobile manufacturers. A similar effort is underway with other center members such as General Motors and the Ford Motor Company. In FY 1993, a total of 64 patents and licensees were issued to the centers.

- $4.00 million, unchanged from FY 1994, for the National Center for Earthquake Engineering Research at SUNY-Buffalo. This center furthers earthquake hazard mitigation through an integrated research and technology transfer program that focuses on the structural and non-structural components of buildings, lifelines (such as power and communications networks), roads, and bridges. It has launched a major new research initiative on civil infrastructure systems to develop guidelines for designing earthquake-resistant highways and bridges and for retrofitting existing systems. Additional funding for the center is provided by other federal agencies and the state of New York.

Facilities

ENG supports user facilities necessary for the conduct of research.

(Millions of Dollars)

	FY 1994 Estimate	FY 1995 Estimate	Percent Change
National Nanofabrication Users Network	$2.20	$2.20	0.0%
Number of Researchers	37	37	0.0%
Number of Students	0	0	0.0%

- ENG provides major research support to explore fundamental phenomena and processes underlying nanostructure technology and micro-electromechanical systems. To support the national infrastructure needs for these burgeoning research fields, ENG, in cooperation with the Mathematical and Physical Sciences (MPS) and Biological Sciences (BIO) Activities, has established the National Nanofabrication Users Network (NNUN), a network of university-based user facilities that offer advanced nano- and micro-fabrication capabilities to researchers in academe, industry, and government.

- In addition to the facilities described above, major experimental/testing facilities have been established through the ERCs which serve both faculty and industry. The wave tank at the Offshore Technology Research Center, a joint ERC with Texas A&M University and the University of Texas at Austin, is capable of generating 3-D waves, currents, and wind to test offshore platforms. The Multidirectional Experimental Laboratory at Lehigh University's ERC for Advanced Technology for Large Structural Systems served nearly 70 private and public-sector firms and agencies during the past year, either as a structural research facility or as a testbed for evaluating their products. The Electron Microscope Facility at the Interfacial Engineering ERC at the University of Minnesota provides scanning tunneling, atomic force, and transmission electron microscopes for industry, faculty, and students for research on the interfaces of materials.

Education and Training

ENG is committed to supporting the improvement of the quality of engineering education, and fostering the attraction and retention of a diverse group of students to yield well-educated, professionally oriented engineers who are able to assume broad leadership roles in industry and society.

(Millions of Dollars)

	FY 1994 Estimate	FY 1995 Estimate	Percent Change
Undergraduate	23.35	26.35	12.8%
Graduate	6.80	7.30	7.4%
Other	30.74	30.74	0.0%
Total Education & Training, ENG	$60.89	$64.39	5.7%

A total of $26.35 million, an increase of $3.00 million over FY 1994, is requested to support undergraduate education and training, including:

- $18.00 million, an increase of $3.00 million over FY 1994, to support the Engineering Education Coalitions Program. The coalitions are developing new approaches to undergraduate engineering education, including both curriculum content and instructional delivery systems. Coalitions develop and test bold, innovative, comprehensive new models for systemic reform of undergraduate engineering education. In FY 1994, the program supports eight coalitions and involves 59 institutions, including universities, community colleges, and one workforce training center. Two of these coalitions have a specific focus on manufacturing for dual-use conversion of defense firms, and are supported through the Technology Reinvestment Project (TRP). The FY 1995 increase will enable the coalitions to include a greater depth of experimentation and testing.

- $3.30 million, the same level as in FY 1994, to support other undergraduate curriculum development activities to ensure that the engineering curriculum in the U.S. keeps pace with developments in research. There are currently 25 projects underway, involving about 75 faculty members, and about 50 graduate and undergraduate students. The FY 1995 program will emphasize the integration of technology management principles into the engineering curriculum through business and engineering faculty partnerships.

- $4.25 million, the same level as in FY 1994, is requested to support over 500 undergraduate students in the Research Experiences for Undergraduates (REU) Program, to permit them to experience, first-hand, the excitement of research careers.

- In FY 1995 $500,000 will also be used to support pilot projects aimed at the integration of telecommunications, computer, and multi-media technologies for new approaches to undergraduate engineering education as part of the Information Infrastructure Technology and Applications program.

- $300,000 for continuing support, at the FY 1994 level, of the Research at Undergraduate Institutions (RUI) program.

- $7.30 million, an increase of $500,000, is requested to provide fellowships and traineeships for graduate students to pursue doctoral studies in engineering, with a special emphasis on the participation of women, underrepresented minorities, and the disabled. The FY 1995 increase will expand the scope of ongoing and new research grants to provide students the opportunity to work on projects of interest to industry. Support will be provided for these students to spend time at industrial sites, working in collaborative teams with industrial personnel and their faculty mentors.

- $30.74 million for grants to facilitate the entry of faculty in the early part of their careers into engineering education/research careers. Through targeted programs, such as the Presidential Faculty Fellows, Research Initiation Awards, and the NSF Young Investigator programs, ENG will continue to maintain support for this group at about 15-20 percent of total investigator-initiated research (not counting SBIR/STTR research).

Number of People Involved in ENG Activities

	FY1993 Estimate	FY1994 Estimate	FY1995 Estimate
Senior Researchers	3,700	4,320	4,820
Other Professionals	610	760	850
Post-Doctorates	320	350	370
Graduate Students	3,560	3,950	4,140
Undergraduate Students	1,490	1,630	1,710
K-12 Teachers	50	60	60
K-12 Students	70	80	80
Total Number of People	9,800	11,150	12,030

ENG Funding Profile

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Total Number of Awards	2,716	2,890	3,020
Statistics for Competitive Awards:			
Number	1,403	1,510	1,600
Funding Rate	22%	25%	27%
Median Annualized Award Size	$61,058	$64,000	$67,000
Average Annualized Award Size	$69,440	$75,000	$77,500
Average Duration (yrs.) \1	2.9	3.0	3.0

1\ Average Duration includes research projects only.

BIOENGINEERING AND ENVIRONMENTAL SYSTEMS $23,530,000

The FY 1995 Budget Request for the Bioengineering & Environmental Systems (BES) Subactivity is $23.53 million, an increase of $1.40 million, or 6.3 percent, over the FY 1994 Current Plan of $22.13 million.

(Millions of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Change Amount	Change Percent
Bioengineering	14.58	16.00	17.10	1.10	6.9%
Environmental & Ocean Systems	5.84	6.13	6.43	0.30	4.9%
Total, BES	$20.42	$22.13	$23.53	$1.40	6.3%

The Bioengineering and Environmental Systems Subactivity supports research aimed at employing engineering principles and techniques to obtain a better understanding of biological, physiological, environmental, and ocean systems.

The Subactivity is concerned with expanding the knowledge base in bioengineering, which includes the engineering aspects of biotechnology (bioprocess engineering), biomedical engineering, and aiding persons with disabilities. With a cross-disciplinary focus, the Bioengineering program element supports the development of an understanding of the functioning of living systems, the use of this understanding to generate a fundamental engineering basis for the economic commercialization of biotechnology, the development of new and improved products for human health care and cost-effective health care delivery, and prosthetic devices and other aids for persons with disabilities.

An example of research reflecting these areas are studies of bacteria, which have only recently been isolated from a variety of geothermal locations, that are able to grow at or above the temperature at which water boils (100 degrees Centigrade). Grantees are investigating methods to understand how enzymes obtained from these bacteria are stable at higher temperatures, and how they can be used as industrial catalysts for the production of fuels, pharmaceuticals, and specialty chemicals.

BES also supports engineering research in environmental and ocean systems aimed at understanding and mitigating the adverse effects of pollutant discharges in the air, land, and water. Such research is conducted to determine new concepts for monitoring, assessing, and taking remedial action. Research is also supported to improve our understanding of ocean systems utilization. Specific areas of ocean engineering research include advanced techniques for sensing, processing, and communicating ocean and sea floor data; synthesis and design of large scale structures, marine materials, sub-sea ocean vehicles and robotics; and methods for living and non-living resource recovery in an environmentally responsible manner. To leverage funding, joint projects are ongoing with Japan and France to study sub-sea vehicles in the coastal environment for use in monitoring, repair, and resource recovery.

The BES budget request includes:

- Bioengineering at $17.10 million, including cross-disciplinary research in biotechnology, biochemical engineering, biomedical engineering and research to aid persons with disabilities, tissue engineering, biosensors, and bioelectronics. A special research initiative, supporting innovative multidisciplinary research contributing toward the containment or reduction of health care costs without compromising quality, effectiveness, or accessibility, will be continued. This program is jointly supported with the privately endowed Whitaker Foundation. The FY 1995 increase of $1.10 million will provide increased support for: (1) bioprocess, biosensing, and biocontrol technologies as part of the Advanced

Manufacturing Technology initiative; and (2) cost-effective health care delivery as part of the **Information Infrastructure Technology and Applications** initiative.

- Environmental and Ocean Systems at $6.43 million, providing support for research on environmental technologies to assess the quality of environmental resources, remediate contaminated sources, and restore their quality for productive use. Also supported is research to foster innovative technologies to conserve, develop, and use the ocean and its resources in an environmentally acceptable manner. The FY 1995 increase of $300,000 provides a special research emphasis on environmental problems unique to coastal regions, including prevention of pollution from diffuse, non-point sources. The ocean systems component will focus on work systems in the ocean and sustainable development of the coastline.

Number of People Involved in BES Activities

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Senior Researchers	260	270	300
Other Professionals	50	50	50
Post-Doctorates	40	40	40
Graduate Students	270	290	310
Undergraduate Students	40	50	50
Total Number of People	660	700	750

CHANGES IN BUDGET STRUCTURE

The Bioengineering and Aid to the Disabled program element has been renamed to Bioengineering because this interdisciplinary field encompasses research to aid the disabled, as well as other multidisciplinary areas.

CHEMICAL AND TRANSPORT SYSTEMS $38,370,000

The FY 1995 Budget Request for the Chemical and Transport Systems (CTS) Subactivity is $38.37 million, an increase of $1.30 million, or 3.5 percent, over the FY 1994 Current Plan of $37.07 million.

(Millions of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Change Amount	Change Percent
Chemical Reaction Processes	9.30	9.90	10.20	0.30	3.0%
Interfacial, Transport and Separations Processes	8.62	9.22	9.56	0.34	3.7%
Fluid, Particulate and Hydraulic Systems	9.19	9.90	10.21	0.31	3.1%
Thermal Systems	7.36	8.05	8.40	0.35	4.3%
Total, CTS	$34.47	$37.07	$38.37	$1.30	3.5%

The CTS Subactivity supports research to improve the understanding of chemical and transport processes from molecular to macroscopic levels. These processes are fundamental to the nation's technological progress in areas such as chemical manufacturing, materials processing, energy and resource production, transportation, pharmaceutical synthesis and purification, and food processing. Applications of this fundamental knowledge extend beyond the traditional chemical industries, which have an exemplary history in the use of fundamental research to develop new products and processes. An active area of material manufacturing research is related to the design and processing of electronic materials, and the fabrication and packaging of microelectronic circuitry.

An environmental initiative begun in FY 1992 continues to support research on environmentally benign chemical and transport manufacturing processes, with pollution prevention at inception as the goal, rather than the end-of-the-pipe waste treatment. The environmental thrust is coordinated with the Chemistry Subactivity of the Mathematical and Physical Sciences Activity, the chemical process industry through the Council for Chemical Research, NIST, and the Environmental Protection Agency.

CTS is working with the Electric Power Research Institute (EPRI) to explore new technologies for electrochemical and microwave chemical processing. Research in this activity has led to several new technologies: a new class of inexpensive catalysts that destroy nitrogen dioxide in power plant stack emissions; improved quality control of a process to manufacture solar collector material; and a new modeling and control strategy for electronic wafer circuitry deposition and etching processes. A partnership is currently underway with the National Water Resources Institute to discover basic mechanisms affecting the performance of separation membranes used to purify water resources.

The major areas of research emphasis in CTS are: environmentally benign processes; materials synthesis and processing; and manufacturing-related issues, including interactions with industry and NIST. Specifically, the request includes:

- Chemical Reaction Processes funding of $10.20 million, supporting ongoing research in the areas of catalysis, kinetics, reaction engineering, and process design and control. The increase of $300,000 in FY 1995 will expand research in the areas of microwave induced reactions and electrochemical processes. Research projects will focus on exploring fundamental prospects for these two phenomena to increase yields and improve selectivity in the synthesis of organic and inorganic molecules, and they have the potential to develop manufacturing technologies that are environmentally benign.

- Interfacial, Transport, and Separations funding of $9.56 million to support continuing investigations in interfacial phenomena, mass transport, separation and purification processes, and phase equilibrium.

The FY 1995 increase of $340,000 will expand research in environmentally receptive and microstructured materials engineering; in chemical separations to understand membranes, chemical and biological fouling, and to improve the performance of membranes in critical enterprises such as water purification, and for support to encourage pioneering processes in chemically programmable interfaces for molecular tailored separations. Examples of recent accomplishments include: a new method of cleaning up toxic metal industrial waste water streams through the use of novel separations membranes; and the fabrication of atomic level multilayer thin films of electrically conductive polymers.

- Fluid, Particulate, and Hydraulic Systems funding of $10.21 million to support ongoing research on turbulent single and multiphase research in various strategic areas. The FY 1995 increase of $310,000 will expand support for studies that take advantage of the power of supercomputers to model the underlying micro-physics of particulate and turbulent flow processes. Such understanding is critical to many industrial processes. The research focus will be on: generation of novel particulate nano-structures and polymeric systems and their corresponding manufacturing processes, such as sintering, extrusion, and molding; and turbulent and multiphase flow past or over-non-traditional shapes, with applications to ground transportation, civil structures, and environmental technologies.

- Thermal Systems funding of $8.40 million to continue studies of heat transfer and combustion processes related to manufacturing and materials processing, as well as improved incineration processes. The increase of $350,000 in FY 1995 will enable studies to be conducted in areas of materials processing such as metal solidification and combustion synthesis that are critical to the manufacture of computer chips and other advanced materials for the electronic and manufacturing industries. Examples of recent accomplishments include the high temperature synthesis of advanced ceramics and metallic materials, diamond films by flame and plasma techniques, and novel laser micro-machining and manufacturing processes for the production of electronic components.

Number of People Involved in CTS Activities

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Senior Researchers	430	460	480
Other Professionals	40	40	50
Post-Doctorates	70	80	80
Graduate Students	550	590	610
Undergraduate Students	60	70	70
Total Number of People	1,150	1,240	1,290

DESIGN, MANUFACTURE, AND INDUSTRIAL INNOVATION $79,860,000

The FY 1995 Budget Request for the Design, Manufacture, and Industrial Innovation Subactivity is $79.86 million, an increase of $13.26 million, or 19.9 percent, over the FY 1994 Current Plan of $66.60 million.

(Millions of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Change Amount	Change Percent
Operations Research and Production Systems	5.73	7.68	7.95	0.27	3.5%
Design and Integration Engineering	5.37	7.56	7.86	0.30	4.0%
Manufacturing Processes and Equipment	10.44	14.46	15.04	0.58	4.0%
Small Business Innovation Research	23.01	31.20	42.31	11.11	35.6%
Management of Technological Innovation	0.50	1.50	1.50	0.00	0.0%
Special Studies and Assessments	1.15	1.40	1.40	0.00	0.0%
Industry/University Liaison	0.00	2.80	3.80	1.00	35.7%
Total, DMII	$46.20	$66.60	$79.86	$13.26	19.9%

The Design, Manufacture, and Industrial Innovation (DMII) Subactivity has primary responsibility for a range of research and analysis programs that promote US. industrial productivity. These programs aim to improve the speed and efficiency by which the results of NSF-supported research and technology are transferred to the marketplace. The Small Business Innovation Research (SBIR) program, which DMII coordinates for NSF, supports high quality research proposals from small firms on important scientific, engineering or science/engineering education problems and opportunities that could lead to significant commercial and public benefit if the research is successful. The Industry/University Liaison Program fosters strategic links between academe and industry that are designed to enhance the competitiveness of U.S. industry. Included in this research initiative is the Small Business Technology Transfer (STTR) Program (Title II. of P.L. 102-564) modeled after the successful SBIR Program, which is designed to stimulate the transfer of technology from research institutions to the market place via cooperative research.

DMII also supports university-based research to develop and expand the scientific and engineering foundations of design, manufacturing, and materials processing for a broad spectrum of U.S. industries. DMII provides many opportunities to increase the linkages between university investigators and industry, linkages that are often essential for successful, manufacturing-related research. The Operations Research and Production Systems program element provides for the development of mathematical optimization techniques that can be applied to product design, production, scheduling, and distribution problems. The Design and Integration Engineering program element provides for the development of the methodologies and tools necessary for the design process itself and for moving product designs through to actual manufacturing operations. The Manufacturing Processes and Equipment program element provides support for the development of innovative new processing and net shape manufacturing techniques for advanced materials, and advanced methods (with appropriate sensors) for computer control of production processes.

DMII is also supporting research in the area of the Transition to Quality Organizations. This support is provided jointly with the Social, Behavioral and Economic Sciences (SBE) Activity. This effort supports research which will aid in the understanding of the principles underlying successful quality-driven transformations. This current thrust was started by a group of companies who have been working with the engineering and business education faculties for a number of years. The companies have realized that a research component is needed and have committed to funding it as has the American Society for Quality Control. In addition, NSF is assisting with the proposal processing and merit review system. It is anticipated that NSF's investment will be leveraged with industry by a factor of four during the next three years of research support.

The DMII budget request includes:

- The Operations Research and Production Systems (ORPS), Design and Integration Engineering (DIE), and Manufacturing Equipment and Processes (MEP) program elements will total $30.85 million to support the **Advanced Manufacturing Technology** (AMT) initiative. Research will focus on next generation manufacturing cells and subsystems, computer-integrated tools for rapid prototyping and manufacture of products, and their integration into production systems. Support is also provided for the Research Deployment Teaching initiative to further encourage faculty to conduct research within an industrial setting. Across all three of the above program elements, $5.00 million will be used to continue the Agile Manufacturing Initiative (AMI). The initiative comprises two parts, namely Agile Manufacturing Research Institutes (AMRI), and an Industry Forum for Agile Manufacturing (IFAM). The IFAM will carry out strategic analyses of business and technical issues affecting agile manufacturing, whereas the results of these analyses will form the research agenda for the AMRIs. The initiative is a joint effort between NSF and the Advanced Research Projects Agency (ARPA). The institutes focus on three industries, namely the machine tool technology industry, the aerospace industry, and the electronics industry.

  Although focused on separate disciplines, there is considerable interaction, cooperation, coordination, and partnership among these programs, and the FY 1995 increase of $1.15 million addresses inter-program issues related to the AMT and HPCC/IITA initiatives. Included in this amount are:

  - an increase of $270,000 in ORPS for the development of mathematical optimization techniques that can be applied to product design, production, scheduling, and distribution problems.

  - an increase of $300,000 in DIE for the development of the methodologies and tools necessary for the design process itself and for moving product designs through to actual manufacturing operations.

  - an increase of $580,000 in MEP for the development of innovative new processing and net shape manufacturing techniques for advanced materials, and advanced methods (with appropriate sensors) for computer control of production processes.

- The Small Business Innovation Research Program increase of $11.11 million, to a total of $42.31 million, provides funding at the mandated level of at least 2.0 percent of extramural research, as required by P.L. 102-564. The program emphasizes commercialization of research results while continuing to support high quality research across the entire spectrum of NSF activities. The program gives special emphasis to the selection of research awards in critical technology areas, such as novel materials, advanced manufacturing, high performance computing and communications, biotechnology, and education at all levels.

- Management of Technological Innovation (MOTI) Program funding of $1.50 million, no change from FY 1994, to provide continued support for interdisciplinary teams consisting of engineering, business, and management scholars conducting research with industry partners. The MOTI Program, which is conducted jointly with the Social, Behavioral and Economic Sciences (SBE) Activity, is aimed at improving the management of the innovation process. Program focus at this time is on environmentally conscious manufacturing, i.e., how to innovate in manufacturing in a way which is benign to the environment.

- $1.40 million for the Special Studies and Assessments Program, no change from FY 1994, to support engineering policy studies and analyses and international technology assessments, including the Japanese Technology Evaluation Center (JTEC).

- The Industry/University Liaison Program increases by $1.00 million to a total of $3.80 million and fosters strategic links between academe and industry that are designed to enhance the competitiveness of U.S. industry. The Program contains two components: the Small Business Technology Transfer (STTR) Program and the Grant Opportunities for Academic Liaison with Industry (GOALI) Program:

- The STTR Program increase of $1.00 million, to a total of $2.40 million, provides funding at the mandated level of at least 0.10 percent of extramural research, as required by P.L. 102-564. The Program will involve small technology intensive firms in exploiting a new reservoir of commercially promising ideas which originate in universities and other nonprofit research institutions. STTR complements the existing SBIR Program. The continued emphasis of the research is the development of new and improved analytical and characterization instruments and sensors having application in chemistry, materials science, biotechnology, or environmental sciences.

- A total of $1.40 million for the GOALI Program, no increase from FY 1994, for continuing support of individual or small-group (2-3 co-investigator) projects and provide engineering faculty with expanded opportunities to enhance their research interests in technologically rich areas, establish long-term relationships with industry, develop collaborative research programs with supplemental funding, and transfer technology to industry. The research emphasis aims to improve basic understanding of and development of engineering design tools in both academe and industry.

Number of People Involved in DMII Activities

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Senior Researchers	1,180	1,570	1,870
Other Professionals	270	390	470
Post-Doctorates	30	40	40
Graduate Students	450	560	600
Undergraduate Students	50	60	70
Total Number of People	1,980	2,620	3,050

CHANGES IN BUDGET STRUCTURE

A new program element, Industry/University Liaison, has been established. It includes: (1) the STTR Program, which was established in FY 1994 in response to Congressional mandate; and (2) the GOALI Program, which incorporates the Industry/University Cooperative Projects program element and other industry/university cooperative efforts that were previously distributed across the ENG Subactivities.

ELECTRICAL AND COMMUNICATIONS SYSTEMS $39,350,000

The FY 1995 Budget Request for the Electrical and Communications Systems Subactivity is $39.35 million, an increase of $2.38 million, or 6.4 percent, over the FY 1994 Current Plan of $36.97 million.

(Millions of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Change Amount	Change Percent
Quantum Electronics, Waves and Beams	9.21	10.04	10.59	0.55	5.5%
Solid State and Microstructures	10.48	11.41	11.77	0.36	3.2%
Communications & Computational Systems	5.21	6.57	7.84	1.27	19.3%
Engineering Systems	8.07	8.95	9.15	0.20	2.2%
Emerging Technologies Initiation	1.15	0.00	0.00	0.00	n/a
Total, ECS	$34.12	$36.97	$39.35	$2.38	6.4%

The Electrical and Communications Systems (ECS) Subactivity supports research to enhance the knowledge base for electrical, electronic, optoelectronic, optical, and electromechanical technologies, and to facilitate their integration into engineering education. ECS research also develops the analytical tools and techniques for computational simulation and control of complex engineering systems.

ECS provides major research support of fundamental phenomena and processes underlying nanostructures technology and microelectromechanical systems (MEMS), which address critical needs in areas such as microelectronics, micro-surgery, micro-sensors, and actuators. To support the national infrastructure needs for these burgeoning research fields, ECS, in cooperation with the Mathematical and Physical Sciences and the Biological Sciences Activities, has established the National Nanofabrication Users Network, a network of university-based user facilities that will offer advanced nano- and micro-fabrication capabilities to researchers in academe, industry, and government.

ECS is increasing research support for optical technologies at the device and systems level that contribute to ultra-high-capacity communications under the **High Performance Computing and Communications** (HPCC) initiative. As part of this activity, ECS has funded, jointly with the Computer and Information Sciences and Engineering Activity (CISE), small-group awards in an All Optical Networks initiative. Through an interagency effort, ECS is also providing funding for university researchers in the US/Japan Joint Optoelectronics Project, which is intended to expand the user base in optoelectronics fabrication, and to stimulate growth of a domestic optoelectronics industry. ECS is also coordinating ENG's participation in the multidisciplinary **Information Infrastructure Technology and Applications** (IITA) initiative.

ECS continues an emphasis on analytical and computational methods for modeling, optimization, and control of complex engineering systems. Recent multidisciplinary efforts which have combined device and processing science with advanced sensors and closed-loop feedback control of semiconductor processing equipment seek to develop a new paradigm for agile manufacturing of complex systems such as for ultra-dense semiconductor circuits.

The ECS budget request includes:

- Quantum Electronics, Waves, and Beams funding of $10.59 million supports fundamental research in quantum electronics, including lightwave technology, plasma engineering, and electromagnetics. The FY 1995 increase of $550,000 provides increased support for optical device and materials technologies important to high performance computing and communications, and for environmental remote sensing research (in collaboration with the Geosciences Activity and U.S. Polar Research

Programs Activity) that require increased engineering emphasis and innovation in areas such as sensor technologies, wave propagation and scattering, and large data set management.

- Solid State and Microstructures funding of $11.77 million supports research on solid-state electronic devices, materials, modeling, processing, magnetism, and MEMS. The increase of $360,000 in FY 1995 emphasizes multidisciplinary research in collaboration with other federal agencies to encourage the utilization of MEMS technologies, and under the **Advanced Manufacturing Technology** initiative, for collaborative efforts in electronic device processing, sensing, and control to develop new paradigms for flexible semiconductor manufacturing.

- Communications and Computational Systems funding of $7.84 million supports research on computational engineering and optical communications systems. The increase of $1.27 million in FY 1995 augments support under the HPCC initiative for: (1) optical systems-level research on all optical networks that will enable high connectivity, multi-gigabit interconnects of remote processors; (2) multidisciplinary research on computationally complex grand challenge problems; and (3) national challenges relating to the Information Infrastructure Technology and Applications (IITA) initiative, such as in environmental research, health care delivery, civil infrastructure systems, advanced manufacturing, and engineering education.

- Engineering Systems funding of $9.15 million supports basic research in analytical and computational methods for the analysis, modeling, optimization, and control of dynamic systems. The FY 1995 increase of $200,000 provides increased support for an initiative conducted jointly with the Electric Power Research Institute that addresses sensors and sensor systems needs for power systems generation and delivery, and other civil infrastructure systems; and for collaborative efforts across ENG that apply advanced optimization and control techniques with sensing for environmental monitoring and pollution avoidance.

Number of People Involved in ECS Activities

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Senior Researchers	480	515	550
Other Professionals	60	60	60
Post-Doctorates	40	40	50
Graduate Students	550	590	630
Undergraduate Students	50	60	60
Total Number of People	1,180	1,265	1,350

CHANGES IN BUDGET STRUCTURE

The Emerging Technologies Initiation Program Element has been terminated in order to consolidate current efforts. Research supported under that program in MEMS has been consolidated within the Solid State and Microstructures program and research on surface phenomena has been picked up by the CTS Subactivity.

ENGINEERING EDUCATION AND CENTERS $92,680,000

The FY 1995 Budget Request for the Engineering Education and Centers Subactivity is $92.68 million, an increase of $4.00 million, or 4.5 percent, over the FY 1994 Current Plan of $88.68 million.

(Millions of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Change Amount	Change Percent
Engineering Education	15.40	18.30	21.80	3.50	19.1%
Human Resources Development	11.44	11.03	11.53	0.50	4.5%
Engineering Research Centers	47.50	51.50	51.50	0.00	0.0%
Industry/University Cooperative Research Centers	6.70	7.85	7.85	0.00	0.0%
Total, EEC	$81.04	$88.68	$92.68	$4.00	4.5%

The Engineering Education and Centers (EEC) Subactivity seeks to stimulate new paradigms in engineering research and education that will accelerate technological innovation and improve the quality and diversity of engineering graduates and the technical workforce. To achieve this mission effectively, EEC forms teams and partnerships across institutions, disciplines, and sectors; shares knowledge and resources to maximize intellectual and technological returns; and integrates programs and activities to focus on major systems and curriculum issues.

In view of the inexorable impact of technology on society, engineers must be ready to assume broader responsibilities and leadership, and be conversant on a wider range of technical and non-technical issues. To this end, quality engineering education must encompass *knowledge* (the scholarship of discovery and understanding), *know-how* (the ability to do and to put knowledge to work), *judgment* (the wisdom to distinguish, to set priorities in utilizing time, energy and resources via strategic planning, and to exercise societal responsibilities), and *character* (all of the above plus the ability to inspire and motivate).

The traditional engineering curriculum has been successful primarily in the knowledge phase and has made some progress in the know-how aspect in recent years. The EEC Subactivity seeks to maintain the existing strength in these areas while redoubling effort to enhance the neglected areas, via such initiatives as the Engineering Education Coalitions; systems- and team-oriented, cross-disciplinary research centers; alternative curricula; and innovative teaching materials from research output. The aim is to equip engineering graduates with improved problem-definition and problem-solving skills and to provide added attraction to recruit and retain a more competent and diverse workforce at all levels. For example, EEC is supporting an Engineering Education Coalition for New Manufacturing Education, jointly with the Technology Reinvestment Project (TRP). The approach is to use a partnership between six universities, Focus:HOPE (an inner-city training center), and the major automobile manufacturers and suppliers, to create jobs and a teaching factory environment for engineering education and vocational training in the city of Detroit.

This Subactivity also includes the Engineering Research Centers (ERCs), which have created a network of alternative research environments where teams of faculty, students, and industry partners carry out fundamental research of strategic importance to engineering systems and next-generation technological advances. The Industry/University Cooperative Research Centers (I/UCRCs) encourage industrial investment in academic research by developing partnerships in which research is defined by the firms supporting each Center. The State Industry/University Cooperative Research Centers program, a part of the I/UCRC program element, is a partnership between the states, industry, and NSF to support research and other activities that contribute significantly to local economic development and the competitiveness of U.S. industry.

In addition, EEC has played a significant team role in the President's Technology Reinvestment Project (TRP), working closely with ARPA, NASA, NIST, DOE, and DOT, particularly in the Manufacturing Education and Training activity area, calling on its unique contacts in and its extensive knowledge base of academe. This multi-agency collaboration will continue into the post-award monitoring phase.

The EEC budget request includes:

- A total of $21.80 million for the Engineering Education program element, an increase of $3.50 million over FY 1994, which includes the following:

    - $18.00 million, an increase of $3.00 million, to support eight Engineering Education Coalitions (including two coalitions funded by the Technology Reinvestment Project). The increase will bring the two coalitions established at the end of FY 1993 to the full planned funding levels. The coalitions are developing new approaches to undergraduate engineering education, including both curriculum structure and content, and instructional delivery systems.

    - $3.30 million for other curriculum development activities to ensure that the engineering curriculum in the U.S. keeps pace with development in research. There are currently 25 projects underway, involving about 75 faculty members working in teams and about 50 graduate and undergraduate students. FY 1995 activities will address this continued need. In addition, an emphasis on the integration of technology management principles into the engineering curriculum will be added into the program by combining business and engineering faculty expertise.

    - In FY 1995, $500,000 will also be used for the HPCC/IITA initiative to support pilot projects aimed at the integration of telecommunications, computer, and multi-media technologies for new approaches to engineering education.

- A total of $11.53 million for Human Resources Development program element to support over 500 undergraduate students in the Research Experiences for Undergraduates (REU) Program, to permit them to experience first-hand the excitement of research careers. It also provides fellowships and traineeships for graduate students to pursue doctoral studies in engineering, especially women, underrepresented minorities, and the disabled. A $500,000 increase in FY 1995 will expand the scope of ongoing and new research grants to provide students the opportunity to work on projects of interest to industry.

- A total of $51.50 million for the Engineering Research Centers, to support a total of up to 22 centers. Between 1985 and 1990, the program established 21 centers, with 18 remaining in operation at the beginning of FY 1994. During FY 1994 the program will add three or four new centers. NSF's annual funding of an ERC ranges from approximately $1.30 to $3.00 million per year, leveraged 2.5 times with support from industry and other sources.

- $7.85 million, no increase from FY 1994, for continuing efforts in the I/UCRC program element. This program has received broad support from the engineering community, the states, industry, and the Congress. Supported within this element are 55 "regular" I/UCRCs. NSF's annual support for these centers ranges between $50,000 and $100,000, leveraged 7 times with industrial support and 15 times with industry and other support combined. Also supported are 13 state I/UCRCs which seek to enhance local and regional economic development, and actively focus on technology transfer and knowledge deployment. The support of these technology-focused centers is shared by NSF, state governments, and industry.

Number of People Involved in EEC Activities

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Senior Researchers	780	860	890
Other Professionals	120	130	140
Post-Doctorates	80	90	90
Graduate Students	1,150	1,265	1,330
Undergraduate Students	1,170	1,285	1,340
K-12 Teachers	50	60	60
K-12 Students	70	80	80
Total Number of People	3,420	3,770	3,930

CIVIL AND MECHANICAL SYSTEMS $46,620,000

The FY 1995 Budget Request for the Civil and Mechanical Systems Subactivity is $46.62 million, an increase of $2.90 million, or 6.6 percent, over the FY 1994 Current Plan of $43.72 million.

(Millions of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Change Amount	Change Percent
Dynamic Systems and Control	3.79	4.20	4.39	0.19	4.5%
Structures, Geomechanics, and Building Systems	8.66	9.51	10.10	0.59	6.2%
Surface Engineering and Tribology	2.52	2.84	2.97	0.13	4.6%
Mechanics and Materials	8.63	9.56	10.10	0.54	5.6%
Earthquake Hazard Mitigation	13.61	15.00	16.23	1.23	8.2%
Natural and Technological Hazard Mitigation	2.59	2.61	2.83	0.22	8.4%
Total, CMS	$39.80	$43.72	$46.62	$2.90	6.6%

The Civil and Mechanical Systems (CMS) Subactivity supports research that enhances fundamental engineering knowledge in mechanical systems, structures, geomechanics, mechanics, materials engineering, tribology, surface engineering, and natural and technological hazards. Results are directly applicable to the improvement of public and private facilities, structures, and civil infrastructure systems; improved manufacturing processes and systems; the mitigation of natural and technological hazards; and other environmental problems.

The Earthquake Hazard Mitigation Program is part of the National Earthquake Hazards Reduction Program (NEHRP), which also includes the Federal Emergency Management Agency (FEMA), the National Institute Of Standards and Technology (NIST), and the U.S. Geological Survey. NSF participation in NEHRP includes research in the Earth Sciences Subactivity of the Geosciences Activity as well as CMS. NSF's role in this multi-agency partnership includes supporting research on buildings and infrastructure, post-earthquake studies (such as those currently underway on the 1994 Los Angeles earthquake), international cooperation, and technology transfer. Within the Earthquake Hazard Mitigation program element, support is provided for the National Center for Earthquake Engineering Research at SUNY-Buffalo, which furthers earthquake hazard mitigation through an integrated research and technology transfer program that focuses on the structural and non-structural components of buildings and bridges.

CMS also provides support to the Institute for Mechanics and Materials (IMM), established in FY 1993 to promote interaction between the mechanics and materials communities, develop a common research agenda, and foster activities that have industrial relevance. An example of this is the inclusion of IMM in the TRP Composite Bridge Project recently awarded to the University of California, San Diego, in which IMM provides the link between the research, education and industrial communities.

Many CMS efforts are jointly supported with other organizations. An example is the intelligent control initiative with the Electric Power Research Institute (EPRI), which seeks to develop advanced control systems that can learn about their environment, process information to reduce uncertainty, and execute control actions in a safe and reliable manner.

The CMS budget request continues to emphasize a major priority: enhancement of the Civil **Infrastructure Systems** Initiative. Within this context, there is increased support for the **Advanced Manufacturing Technology** and **Information Infrastructure Technology and Applications** initiatives. The request includes:

- $4.39 million for Dynamic Systems and Control, to support fundamental research in nonlinear behavior of materials, noise and vibration suppression, and control of machines and mechanical systems. The FY 1995 increase of $190,000 will increase research on innovative and efficient control systems that perform with a high degree of accuracy and reliability in uncertain and flexible manufacturing environments.

- $10.10 million for the Structures, Geomechanics, and Building Systems program element. Ongoing activities support research to improve system performance and longevity of existing and future civil infrastructure systems utilizing deterioration science (failure, corrosion, fatigue, etc.), renewal engineering (repair/retrofit, structural control, construction automation, etc.), and assessment technologies (nondestructive evaluation, advanced instrumentation, and expert systems). The FY 1995 increase of $590,000 will expand research on: (1) development of new nondestructive evaluation techniques to assess the condition of decaying civil infrastructure systems; (2) structures, geomechanics, and environmental geotechnology that will assist in the innovative remediation of such facilities; (3) intelligent materials handling and new construction materials and processes to reduce future infrastructure problems; and (4) control devices that counteract weaknesses and/or deformations.

- Surface Engineering and Tribology funding of $2.97 million, with an increase of $130,000 to support research that addresses the characteristics of surfaces and their effects on the performance of mechanical components and structures subject to friction, mechanical and thermal stresses, and corrosion.

- $10.10 million for the Mechanics and Materials program element. Ongoing research will focus on developing a fundamental understanding of deformation and damage mechanisms to produce material models that predict macro-behavior from the material microstructure. This requires advances in experimental, analytical, and high performance computing methods. The increase of $540,000 will expand research on the development of innovative manufacturing processes for advanced materials with enhanced product properties and improved mechanical performance.

- A total of $19.06 million, an increase of $1.45 million, is requested for research on Earthquake Hazard Mitigation and Natural and Technological Hazard Mitigation (e.g., damaging winds, floods, landslides). This is a special research emphasis within the Civil Infrastructure Systems initiative. Significant improvement in design of structures subjected to these hazards has resulted because of research in the last decade. Increased emphasis will be given to research to develop rational assessment methods and cost-effective retrofit techniques for existing structures exposed to seismic hazards. Also, the recent Mississippi river floods are being used as a natural laboratory by researchers to develop new knowledge that will be useful in reducing the impacts of future extreme events.

Number of People Involved in CMS Activities

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Senior Researchers	580	640	680
Other Professionals	80	90	90
Post-Doctorates	60	60	70
Graduate Students	600	660	710
Undergraduate Students	100	110	120
Total Number of People	1,420	1,560	1,670

CHANGES IN BUDGET STRUCTURE

The Natural and Man-Made Hazard Mitigation program element has been renamed the Natural and Technological Hazard Mitigation Program, in order to better describe its nature and scope.

GEOSCIENCES $443,090,000

The FY 1995 Budget Request for Geosciences (GEO) is $443.09 million, an increase of $39.22 million, or 9.7 percent, over the FY 1994 Current Plan of $403.87 million.

(Millions of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Change Amount	Change Percent
Atmospheric Sciences	126.50	134.37	147.87	13.50	10.0%
Earth Sciences	75.75	80.57	87.29	6.72	8.3%
Ocean Sciences	179.35	188.93	207.93	19.00	10.1%
Total, GEO	$381.60	$403.87	$443.09	$39.22	9.7%

GEO supports research in the atmospheric, earth, and ocean sciences. As the principal source of Federal funding for university-based fundamental research in the geosciences, GEO contributes to the nation's need to understand, predict and respond to environmental events and changes, and to use Earth's resources wisely. Research in the geosciences advances the scientific knowledge of Earth's environment, including resources such as water, energy and minerals, and advances the ability to predict natural phenomena of economic and human significance, such as weather, climate changes and earthquakes.

The ultimate purpose of research in the geosciences is to improve understanding of Earth processes and to lay the scientific groundwork for others to use in formulating policy and making decisions on important societal issues. For example, NSF, a principal agency in the National Earthquake Hazards Reduction Program, is able to significantly advance the state of mitigation and preparedness in the nation through timely studies on earthquake processes and engineering. When earthquakes occur, as in the recent Northridge, California, earthquake, the GEO-supported Southern California Earthquake Center serves as a center to capture data, coordinate science activities, and provide public information.

GEO's priorities for support, as reflected in this budget request, are:

- Strategic national initiatives, especially the **U.S. Global Change Research Program** (USGCRP) and **High Performance Computing and Communications**;
- Highest quality **research and education in the atmospheric, earth, and ocean sciences** through individual research grants, coordinated field programs, and research centers;
- **Instrumentation and facilities** (including ships, aircraft, computers, radars, seismographs, and data management systems) needed to do world-class research in the geosciences.

Research in Strategic Areas

Examples of research in strategic areas include:

(Millions of Dollars)

	FY 1994 Estimate	FY 1995 Estimate	Percent Change
Advanced Materials & Processing Program	8.00	8.00	0.0%
Biotechnology	4.00	3.60	(10.0%)
Environmental Research	23.15	23.65	2.2%
High Performance Computing & Communications	2.92	6.92	137.0%
Science, Math, Engineering and Technology Education	9.20	9.20	0.0%
U.S. Global Change Research Program	99.24	134.46	35.5%

Note: Projects which have strong connections to the goals and objectives of more than one initiative are difficult to attribute to single initiative. In an effort to present a more precise measure of its research and education initiatives, NSF will redefine its internal data collection and analysis capabilities so that the allocation of resources for these initiatives can be shown in a mutually exclusive manner.

The FY 1995 Budget Request includes the following:

- GEO's component of the **U.S. Global Change Research Program** (USGCRP) totals $134.46 million in FY 1995, an increase of $35.22 over FY 1994. Ongoing activities include continued support of programs coordinated internationally to observe, understand, and model atmospheric, oceanic, and terrestrial processes and their coupled interactions. Studies include ocean circulation, glacial dynamics, ocean-atmosphere interactions, cloud-radiation, global atmospheric chemistry, biogeochemical processes, land-sea interactions, past climate change, crustal and related processes impacting global change, ocean ecosystems, solar processes, data bases, and climate system modeling and prediction.

  The FY 1995 increase will provide for additional research across the GEO Subactivities in the following areas:

  - **International data collection campaigns** such as:

    World Ocean Circulation Experiment (WOCE), which has as its main goal understanding the global ocean circulation well enough to model its present state and predict its evolution in response to long-term climate changes;

    International Global Atmospheric Chemistry Program (IGAC), which has as its major focus understanding and predicting the natural and human induced changes in atmospheric composition which can affect the climate;

    Water and Energy: Atmospheric, Vegetative, and Earth Interactions (WEAVE), NSF's principal contribution to the Global Energy and Water Cycle Experiment (GEWEX) under the World Meteorological Organization's World Climate Research Program; and

    Earth System History (ESH) which supports research on factors that govern environmental variability, rates of climate change, and large-scale response to climate forcing and is the major U.S. contribution to the International Geosphere-Biosphere Programme's project on Past Global Changes (PAGES).

  - **Forecasting and climate modeling** through Climate Modeling, Analysis and Prediction (CMAP), which supports projects to develop integrated, predictive models of the complex climate system.

  - The development of new methodologies for conducting **integrated assessments** of environmental issues, bringing research results from natural, social and policy sciences into a common framework to help decision makers.

- **Environmental Research** totals $23.65 million in FY 1995, an increase of $500,000. Ongoing activities include basic research for the improved understanding of processes that govern changes in the Earth's environment. Research in FY 1995 will continue to focus attention on understanding the geochemistry of near-surface environments, biodiversity in the marine environment, toxic algae blooms, coral reef ecosystems and the geochemical cycling of nutrients and contaminants across land, estuary and ocean interfaces.

- Research in **High Performance Computing and Communications** totals $6.92 million in FY 1995, an increase of $4.00 million. Ongoing activities include support for the National Center for Atmospheric Research (NCAR) and several universities to develop algorithms which most effectively use parallel computers in the context of geophysical models and to determine which technological options are most likely to produce high performance systems that will meet future needs.

  Increased funding in FY 1995 will support the acquisition, maintenance and operation of a new parallel computer at NCAR, the enhancement of networking technology to allow the dissemination of near-real time data over the Internet, and, as part of the **Information Infrastructure Technology and Applications** (IITA) component, development of services, standard tools, and user interfaces for storing, accessing and analyzing three dimensional geophysical data.

- Research in the **Advanced Materials and Processing Program** totals $8.00 million in FY 1995, maintaining the FY 1994 level of funding. Ongoing activities include fundamental research on the physics and chemistry of earth materials, especially at high temperatures and pressures. Research in FY 1995 will focus specifically on research on theory, modeling and simulation of new materials: synthesis of high-pressure, high temperature materials; and characterization of the properties and behavior of earth materials, particularly magnetic and high-pressure materials.

- Research in **Biotechnology** totals $3.60 million in FY 1995, slightly less than in FY 1994. Ongoing activities will focus on linking basic research on marine systems with technologies that contribute to the development of new products and processes. Support is provided in areas such as biodegradation/decomposition processes by marine organisms, with potential application in bioremediation of contaminated marine systems; and for discovery and understanding of natural products from marine organisms with potential drug use in human and commercially important animal systems.

- **Science, Mathematics, Engineering and Technology Education** support totals $9.20 million in FY 1995, level with FY 1994. Ongoing activities include support for special postdoctoral opportunities and undergraduate activities through programs such as Research in Undergraduate Institutions (RUI) and Research Experiences for Undergraduates (REU).

Modes of Support

GEO provides support for research and educational activities in a variety of modes as indicated by the following table:

(Millions of Dollars)

	FY 1994 Estimate	FY 1995 Estimate	Percent Change
Research Projects	264.98	293.56	10.8%
Centers	7.83	7.99	2.0%
Facilities	120.21	130.69	8.7%
Education & Training	10.85	10.85	0.0%
Total, GEO	$403.87	$443.09	9.7%

Research Projects

Funding for research projects totals $293.56 in FY 1995, an increase of $28.58 million. The increase is directed primarily to research related to the USGCRP, across GEO Subactivities and programs. Recent accomplishments of ongoing research are highlighted below.

- Research projects in Atmospheric Sciences improve the understanding and prediction of climate, weather, and the global environmental system:
    - A recently completed experiment in the western Pacific Ocean, the Tropical Oceans-Global Atmosphere Coupled Ocean-Atmosphere Response Experiment (TOGA COARE), the largest, most complex environmental field project ever undertaken, produced an unprecedented climate data set that will be a resource for studying ocean-atmosphere interactions for several decades. TOGA COARE involved hundreds of scientists, students and technicians from 20 nations, and was jointly supported by NSF, National Oceanic and Atmospheric Administration (NOAA), National Aeronautics and Space Administration (NASA) and the Department of Defense.
    - Recent studies indicate that thin polar clouds at heights of approximately 90 kilometers may be especially sensitive indicators of climate change. To obtain further understanding a comprehensive observing campaign was conducted in 1993. This campaign featured flights to the Arctic using the NCAR Electra aircraft equipped with special remote sensing instrumentation from the University of Illinois, the Lockheed Corporation, Utah State University, and Johns Hopkins University. There was significant additional support from the Canadian Network for Space Research and NASA satellites.
- Research projects in Earth Sciences are conducted by individual investigators and small groups in order to understand the processes that govern the distribution of water, energy, and mineral resources, the safe disposal of toxic wastes, the occurrence and impact of natural hazards from earthquakes, volcanic eruptions and landslides, and the responsible use of land:
    - Data from the 1993 floods in the Upper Mississippi Basin are being used by researchers to protect river systems against bank and levee sloughing and to determine the degree to which major floods recharge aquifers mined by irrigators and industries during normal years.
    - Results from independent basic research can serve as the foundation for further research and applications. For example, reconstructions of paleo-atmospheric carbon dioxide content

(University of Utah, University of Tennessee, Yale University) coupled with measurements of paleotemperature indicators (University of Michigan, Princeton University, University of Arizona, University of California-Santa Cruz) are allowing climate modelers at Pennsylvania State University to test the sensitivity of climate change to changes in carbon dioxide in the atmosphere.

  - Other researchers have analyzed sediments drilled on and near the New Jersey shore in deep water to study ancient sea level changes in order to understand how the Earth responded to natural temperature shifts. This knowledge is crucial to the prediction of how the Earth would respond to the increase in greenhouse gases.

- Research projects in Ocean Sciences improve our understanding of the global climate system, coastal environments, marine resource assessment, and estuarine and larger lake ecosystems. Activities include a broad spectrum of research projects that focus on processes that control the chemical composition and motion of ocean waters, the nature and distribution of marine organisms, and the character of the ocean floor:

  - Global Ocean Systems Dynamics (GLOBEC), jointly funded by NSF and NOAA, is mounting its first major field program with Canadian scientists to understand how ocean climate controls major fish stock levels.

  - Researchers have recently discovered two new active hydrothermal vent sites at the northern mid-Atlantic Ridge and on Juan de Fuca Ridge in the Pacific. The Juan de Fuca vent site provided the first detection and observations of an underwater eruption from the time of eruption. This was made possible by use of the Navy's SOSUS array, a series of hydrophones on the ocean floor previously used for defense purposes. Their detection of the eruption allowed a series of response studies by NOAA and NSF-funded investigators. These studies will provide a better understanding of the volcanic, chemical, and biological processes associated with sea floor hydrothermal vents, as well as information on the amount of heat and chemicals dispersed by the eruptions.

Centers

GEO supports four Science and Technology Centers:

- Center for the Analysis and Prediction of Storms (CAPS)
- Center for Clouds, Chemistry and Climate (C4)
- Southern California Earthquake Center (SCEC)
- Center for High Pressure Research (CHiPR)

(Millions of Dollars)

	FY 1994 Estimate	FY 1995 Estimate	Percent Change
Science and Technology Centers	$7.83	$7.99	2.0%
Number of Researchers	147	151	2.7%
Number of Students	128	142	10.9%

The research agendas of the four STC's require a center environment because of the multidisciplinary and highly complex nature of their scientific objectives. Over 270 scientists and students use the four centers each year. Additional people participate in workshops, conferences and special projects, such as pre-college students' visits and field projects. Support for centers increases $160,000 to $7.99 million in FY 1995.

Successful collaborations have been established with numerous Federal, state and local agencies, universities and industry. Collaborative research includes, for example, the development of algorithms for climate prediction (National Oceanic and Atmospheric Administration) and the evaluation and calibration of satellite data relevant to the earth's heat budget and cloud-radiative feedbacks to climate change (Department of Energy, Department of Defense, and National Aeronautics and Space Administration).

- The objectives of the Center for the Analysis and Prediction of Storms include the development of sophisticated computer models for the analysis, prediction, and visualization of thunderstorms and associated severe weather. The fields of science include dynamic meteorology, cloud physics, applied mathematics, and computer science.

  Intensive interagency interaction and support for CAPS involve NOAA and the Federal Aviation Administration (FAA). Industry collaboration includes working relationships with Cray Research and IBM. A major new storm prediction model has been developed and is presently being tested in cooperation with the NOAA Severe Storms Laboratory. CAPS is also being supported by the FAA to do research that may be used to develop tools for the prediction of severe weather to assist air traffic controllers.

- The objectives of the Center for Clouds, Chemistry and Climate include improving the understanding of the roles of clouds and chemistry in climate change. The fields of science involved include cloud physics, radiative transfer, atmospheric chemistry, and atmospheric dynamics. Applied mathematics and statistics, computer sciences and instrument development expertise are also required

  C4 has successfully conceived and carried out the Central Equatorial Pacific Experiment (CEPEX), a major field project in FY 1993. CEPEX was designed to test the "thermostat" hypothesis: a process to explain the observed stability of the warm sea surface temperatures of the tropical Pacific Ocean. The data analyses are now underway.

- The Southern California Earthquake Center has emerged as a focal point for new earthquake research in southern California. It has formed unprecedented cooperation between the major southern California universities, Federal, state and local agencies and private corporations, to understand the earthquake process and develop a socially useful probabilistic seismic hazard model for the region. Results to date are extending and redefining the physical models on which seismic hazard estimates are based. These advances can be useful for other seismically active regions, by demonstrating how the combination of earthquake, space positioning and geologic data can refine probability estimates of earthquake hazard.

  Scientists from the Center have recently used the Department of Defense's Global Positioning System to give a snapshot of crustal distortion in southern California that is a direct measurement of long term earthquake hazard.

- The Center for High Pressure Research has brought together multidisciplinary teams of universities, national laboratories, and industry to study the effects of pressure on earth, planetary, and synthetic materials. Research has significantly extended the range of pressure and simultaneous temperature achievable in diamond-anvil and large volume multi-anvil pressure cells and has interfaced the high-pressure systems with synchrotron radiation and other probes for characterizing the structure and properties of matter.

  The Center has forged links with industry (Norton Company, DuPont, GTE, Grumman, and Morris Research), has worked on the development of new products, and has synthesized high-pressure phases such as a high-temperature superconductor for the Center for Superconductivity at the University of Illinois.

Facilities

GEO supports user facilities necessary for the conduct of research. These include large, national user facilities such as the National Center for Atmospheric Research (NCAR) and the U.S. academic fleet, and smaller facilities in atmospheric, earth, and ocean sciences. NSF support provides for ongoing operations and maintenance, including upgrades to existing facilities as well as regularly scheduled repair.

(Millions of Dollars)

	FY 1994 Estimate	FY 1995 Estimate	Percent Change
National Center for Atmospheric Research	51.80	56.49	9.1%
Academic Research Fleet/Ship Operations	49.06	52.55	7.1%
Upper Atmospheric Sciences Facilities	7.10	7.73	8.9%
Earth Sciences Facilities	11.05	12.52	13.3%
Ocean Sciences Accelerator Mass Spectrometry Center	1.20	1.40	16.7%
Total Facilities Support, GEO	$120.21	$130.69	8.7%
Number of Researchers	1,544	1,563	1.2%
Number of Students	1,129	1,136	0.6%

- Support for NCAR totals $56.49 million in FY 1995, an increase of $4.69 million over FY 1994. Ongoing activities include operation and maintenance of observing and computer facilities. NCAR is the world center for atmospheric research with an active visitor program. Since its creation in 1960, about 30,000 people from 250 institutions across the country and around the world have visited NCAR and used their facilities. In FY 1994, approximately 1500 researchers and students will use the facilities and about 150 visiting scientists will stay for extended periods.

  Additional funding in FY 1995 will allow the aircraft and computer facilities to be improved and additional atmospheric chemistry instrumentation to be developed. The budget increase will allow more deployment of facilities, an accelerated research effort in earth system modeling related to the USGCRP, and a greater number of visitors and facilities users.

- Support for academic research fleet ship operations totals $52.55 million in FY 1995, an increase of $3.49 million over FY 1994. Approximately 250 projects for over 3400 operating days for 26 ships are projected. The projects range from individual investigator studies of coastal waters to integrated multi-investigator studies for the major components of the USGCRP. A major emphasis in FY 1995 will be on international programs in the Indian Ocean.

- Support for Upper Atmospheric Facilities (UAF) totals $7.73 million in FY 1995, an increase of $630,000 over FY 1994. Ongoing activities include supporting observatories in Puerto Rico, Greenland, the U.S. (Massachusetts) and Peru. These facilities are of vital importance to this nation's ground-based studies of the upper atmosphere and nearby geospace. In FY 1995 the increase will allow the continued operation of these facilities and modest instrumentation improvements.

- Within Earth Sciences Facilities, Incorporated Research Institutions for Seismology (IRIS) totals $8.4 million in FY 1995, an increase of $800,000 over FY 1994. IRIS was started in 1986 to install a global network of wide band digital seismometers (Global Seismic Network, or GSN), provide portable seismometers for regional studies, and assemble a data management system that provides on-line, distributed access to all data on global seismicity. To date, IRIS has installed 55 GSN stations and purchased 300 portable instruments. The data management system has stored up to half a terrabyte of seismic records and made use of information highways, such as Internet, to service over 6,000 requests for seismic waveform data from all over the world.

IRIS facilities provide rapid analysis of damaging earthquakes, aid in monitoring nuclear proliferation, and permit tomographic imaging of the convective motions deep within the Earth. In FY 1995, increased support will allow the continued operations of these facilities and an increase in GSN stations and portable instruments.

Other support includes facilities for geodetic use of the Global Positioning System, and multi-user analytical facilities such as mass spectrometers and synchrotron beamlines.

- Support for the National Ocean Sciences Accelerator Mass Spectrometry Center at Woods Hole Oceanographic Institution totals $1.40 million in FY 1995, an increase of $200,000 over FY 1994. The facility provides radiocarbon dating services for the oceanographic research community, with a focus on carbon dioxide analyses for the USGCRP climate and hydrologic systems programs. Research to develop new isotopic dating techniques will continue.

- Consistent with direction provided by Congress, action on acquisition of an Arctic research vessel has been deferred pending outcome of a General Accounting Office analysis of acquisition options.

Education and Training

Research in the geosciences requires an adequate supply of highly trained people. GEO will continue to support undergraduates, graduate students, postdoctoral professionals, and junior faculty.

(Millions of Dollars)

	FY 1994 Estimate	FY 1995 Estimate	Percent Change
Undergraduate	5.54	5.84	5.4%
Postdoctoral	3.66	3.36	(8.2%)
Other	1.65	1.65	0.0%
Total Education & Training, GEO	$10.85	$10.85	0.0%

The FY 1995 Budget Request includes the following:

- $5.84 million to provide continued support for undergraduates including hands-on research experience for students, research support for faculty at undergraduate institutions and other opportunities to attract underrepresented minorities to the geosciences.

- $3.36 million for postdoctoral fellowships in atmospheric, earth, and ocean sciences.

- $1.65 million to enable outstanding new faculty to pursue research and teaching in academic institutions through Presidential Young Investigator/NSF Young Investigator awards.

In addition to these activities, students from more than 60 elementary and secondary school classrooms studied the oceanographic and atmospheric conditions that drive coastal currents, and used this information to predict the location of three oceanographic drifters released at the mouth of the Delaware Bay by a researcher funded through the Ocean Sciences Subactivity.

Number of People Involved in GEO Activities

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Senior Researchers	3,970	4,005	4,005
Other Professionals	2,990	3,020	3,050
Post-Doctorates	460	490	520
Graduate Students	1,780	1,780	1,780
Undergraduate Students	660	690	720
Total Number of People	9,860	9,985	10,075

GEO Funding Profile

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Total Number of Awards	2,486	2,520	2,520
Statistics for Competitive Awards:			
Number	1,258	1,270	1,270
Funding Rate	39%	38%	37%
Median Annualized Award Size	$58,803	$61,000	$64,000
Average Annualized Award Size	$110,957	$115,000	$122,000
Average Duration (yrs.) \1	2.4	2.5	2.6

1\ Average Duration includes research projects only.

ATMOSPHERIC SCIENCES $147,870,000

The FY 1995 Budget Request for the Atmospheric Sciences Subactivity (ATM) is $147.87 million, an increase of $13.50 million, or 10.0 percent, over the FY 1994 Current Plan of $134.37 million.

(Millions of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Change Amount	Change Percent
Atmospheric Sciences Project Support	69.44	75.47	83.65	8.18	10.8%
National Center for Atmospheric Research	50.17	51.80	56.49	4.69	9.1%
Upper Atmospheric Facilities	6.89	7.10	7.73	0.63	8.9%
Total, Atmospheric Sciences	$126.50	$134.37	$147.87	$13.50	10.0%

Research in the Atmospheric Sciences Subactivity improves the understanding and prediction of weather, climate, and the solar-terrestrial system by expanding the knowledge of the composition and dynamics of the Earth's atmosphere and geospace environment. Over one-third of the funds for Atmospheric Sciences support the operation and maintenance of large, complex facilities required for research in the atmospheric and geospace environment. The National Science Foundation provides approximately 50 percent of the total Federal support for basic research in atmospheric sciences.

Atmospheric Science Project Support includes research in physical meteorology, large-scale dynamic meteorology, experimental meteorology, climate dynamics, atmospheric chemistry, aeronomy, magnetospheric physics and solar-terrestrial relations.

The National Center for Atmospheric Research in Boulder, Colorado conducts research in all fields of atmospheric sciences and provides major facilities such as supercomputers, aircraft and ground-based observing facilities for use by the entire community.

Upper Atmospheric Facilities supports observatories in Puerto Rico, Greenland, the U.S. (Massachusetts) and Peru for ground-based studies of the Earth's upper atmosphere and geospace.

The FY 1995 Budget Request includes:

- $44.78 million, including a requested increase of $12.2 million, for enhanced support of the **U.S. Global Change Research Program**. This includes activities to improve climate system modeling and data management. Also supported are activities that are a part of the International Geosphere-Biosphere Programme, the World Climate Research Program, and other international programs, which undertake coordinated research in global atmospheric chemistry, atmospheric and oceanic coupling, the global water and energy cycles, the history of past climate changes and solar terrestrial relationships. USGCRP funding includes support for research projects as well as for facilities required to undertake the research.

- $3.46 million, including a requested increase of $1.30 million, for enhanced participation in the **High Performance Computing and Communications** initiative. Support is provided to study technology options of high performance systems for current and future computational needs, including the acquisition and testing of new architecture computers and development of algorithms which effectively use parallelism in running geophysical models. The **Information Infrastructure Technology and Applications** (IITA) component will enhance the development of services, standard tools, and user interfaces for storing, accessing, and analyzing three dimensional geophysical data.

- $2.87 million for two Science and Technology Centers: The Center for Analysis and Prediction of Storms has as its goal improving short term forecasts of severe weather. The Center for Clouds, Chemistry and Climate conducts research on the climate feedbacks resulting from changes in atmospheric composition induced by human activity, and on the properties and distribution of clouds.

- $2.65 million for educational and human resource programs, including undergraduate research, postdoctoral fellowships, and special activities to increase minority participation in atmospheric sciences.

- $46.50 million for core support of other disciplinary research in meteorology, climate, atmospheric chemistry, aeronomy and space physics, including activities in support of the U.S. Weather Research Program.

- $47.61 million for the general support of atmospheric science facilities including the National Center for Atmospheric Research and the Upper Atmospheric Facilities. These facilities, shared by the atmospheric science community, include aircraft, supercomputers, remote sensing devices and powerful upper atmospheric observatories. Together with facilities funding provided through the USGCRP and HPCC initiatives, total funding for atmospheric facilities will be $64.22 million in FY 1995.

Number of People Involved in ATM Activities

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Senior Researchers	1,960	1,970	1,970
Other Professionals	1,740	1,750	1,760
Post-Doctorates	230	240	250
Graduate Students	580	580	580
Undergraduate Students	180	190	200
Total Number of People	4,690	4,730	4,760

EARTH SCIENCES $87,290,000

The FY 1995 Budget Request for the Earth Sciences Subactivity (EAR) is $87.29 million, an increase of $6.72 million, or 8.3 percent, over the FY 1994 Current Plan of $80.57 million.

(Millions of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Change Amount	Change Percent
Earth Sciences Project Support	51.50	53.20	57.66	4.46	8.4%
Instrumentation and Facilities	17.92	20.10	21.76	1.66	8.3%
Continental Dynamics	6.33	7.27	7.87	0.60	8.3%
Total, Earth Sciences	$75.75	$80.57	$87.29	6.72	8.3%

The Earth Sciences Subactivity supports research in geology, geophysics, geochemistry and hydrology and related fields such as tectonics, paleontology, and seismology. It supports field, laboratory, theoretical and computational studies on the structure, composition, and history of the Earth and its processes. These studies provide the fundamental scientific basis for the discovery and exploitation of mineral, energy, and water resources; the prediction and mitigation of natural hazards such as earthquakes, volcanic eruptions, landslides and floods; and for environmentally sound use of the Earth by society.

Support for Earth Sciences is administered through three program elements: Instrumentation and Facilities which deals with shared research facilities and university instrumentation including development of new instruments for Earth Science research; Continental Dynamics which deals with coordinated multidisciplinary and multi-institutional field projects on the continents; and Earth Sciences Project Support which deals with individual and small group research proposals in all disciplines of the Earth Sciences as well as postdoctoral fellowships and other human resources awards. All three program elements participate in the funding of the special initiatives and programs noted below.

The FY 1995 Budget Request includes:

- $12.52 million for support of Earth Science facilities, including Incorporated Research Institutions for Seismology (IRIS) -- the Global Seismic Network and its associated Data Management System; facilities for geodetic use of the Global Positioning System; and shared analytical facilities such as accelerator-based mass spectrometers, ion-beam microprobes, and synchrotron beam lines.

- $5.11 million, including an increase of $160,000, to support and enhance two Science and Technology Centers: the Southern California Earthquake Center with the goal of reducing the earthquake hazard to Southern California and other earthquake-prone regions, and the Center for High-Pressure Research focusing on the study of the nature and properties of materials under extreme conditions of high pressure and high temperature.

- $18.23 million, including an increase of $5.22 million, for enhanced support of the **U.S. Global Change Research Program** through the study of hydrologic interactions among the atmosphere, the land, and the biosphere; the geological record of past global changes; and past and current changes in sea level.

- $1.87 million, including an increase of $1.50 million, for support of activities in **High Performance Computing and Communications**, including development of new geophysical models and support of infrastructure for rapid distribution of geophysical data.

- $2.86 million for support of educational and human resource programs including undergraduate research, postdoctoral fellowships, and special activities to increase minority participation in the geosciences.
- $46.70 million, a decrease of $160,000, for investigator-initiated projects in other areas of the geosciences. Special emphasis will be given to environmental geochemistry, hydrology, active tectonics, and studies of the Earth's deep interior.

These figures include level funding of $10.90 million for activities that are part of the National Earthquake Hazard Reduction Program.

Number of People Supported in EAR Activities

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Senior Researchers	860	870	870
Other Professionals	170	180	190
Post-Doctorates	130	140	150
Graduate Students	650	650	650
Undergraduate Students	250	260	270
Total Number of People	2,060	2,100	2,130

OCEAN SCIENCES $207,930,000

The FY 1995 Budget Request for the Ocean Sciences Subactivity (OCE) is $207.93 million, an increase of $19.00 million, or 10.1 percent, over the FY 1994 current plan of $188.93 million.

(Millions of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Change Amount	Change Percent
Ocean Sciences Research Support	91.79	99.99	113.98	13.99	14.0%
Oceanographic Centers and Facilities	51.70	50.26	53.95	3.69	7.3%
Ocean Drilling Program	35.86	38.68	40.00	1.32	3.4%
Total, Ocean Sciences	$179.35	$188.93	$207.93	$19.00	10.1%

The Ocean Sciences Subactivity supports research to improve understanding of the sea, including the sea floor and the organisms in it and its relationship to human activities and environmental change, through three program elements.

Ongoing research areas within Ocean Sciences Research Support include physical oceanography, chemical oceanography, marine geology and geophysics, biological oceanography and oceanographic technology and interdisciplinary studies. Research studies focus on factors controlling physical, chemical, geological and biological processes in the oceans and at its boundaries. Projects range from individual investigator work to understand the nature of individual marine organisms or species to multi-investigator contributions to the USGCRP that use substantial amounts of ship and facility time.

Oceanographic Centers and Facilities includes ship operations, instrumentation and technical services, and oceanographic facilities and coordination activities. The programs provide support for research ships and specialized shared-use facilities and equipment operated by U.S. academic oceanographic institutions, marine technicians, instrumentation and equipment acquisition, and construction or refitting of research ships as required.

The Ocean Drilling Program is a multinational program of basic scientific research in the oceans which uses drilling and logging to improve fundamental understanding of the physical, chemical and biological processes that determine the geological history, structure and evolution of the oceanic portion of the earth's crust. Operations support is shared with 6 international partners, comprising 28 other countries, and funds drilling operations and all associated logistics and scientific services. The joint operations include ship and shore laboratories, core repositories and associated data banks containing samples and records, an engineering development program for drilling technology and a center to develop and operate down-hole logging instruments. Research support includes individual investigator projects to participate onboard the drillship, JOIDES Resolution, and analyze samples and logging data. Field programs to define the regional geologic framework for future drilling are also included.

The FY 1995 Budget Request includes:

- $71.44 million, including an increase of $17.80 million, for enhanced support of the **U. S. Global Change Research Program** with a focus on field programs, modeling, integrated assessments, and ecological studies. Major program components and planned activities include:
  - World Ocean Circulation Experiment (WOCE) will conduct a major Indian Ocean field expedition and initiate implementation of high resolution global ocean climate models;

  - Tropical Ocean Global Atmosphere (TOGA) will extend coupled ocean-atmosphere models for El Niño prediction based on new field data; Joint Ocean Flux Studies (JGOFS) will conduct an Arabian Sea Expedition with multi-agency and multinational coordination to determine carbon flux and physical controls related to monsoon seasons;
  - Global Ecosystems (GLOBEC) will continue an international field program in the northwest Atlantic with emphasis on regional relationships between ocean climate and fish stocks;
  - Land-Margin Ecosystems Research (LMER) will expand field programs to include additional representative U.S. environments, for example, the Great Lakes region;
  - Arctic Systems Science (ARCSS) will implement a field program using ice breaker support to examine heat balance in the Arctic;
  - Marine Earth System History (MESH) will initiate studies on dynamics of rapid climate change and instabilities in natural climate systems;
  - RIDGE Interdisciplinary Global Experiment (RIDGE) will enhance efforts in detection of volcanic events on the sea floor and monitoring of subsequent oceanic responses in the Juan de Fuca ridge system off Washington state.

  Support is included for individual and multi-disciplinary research projects ($49.04 million) and ship operations and other facilities to conduct the required field programs ($22.40 million).

- $1.61 million, including an increase of $1.20 million, for support of activities in **High Performance Computing and Communications**. Research will be accelerated in development of code for transfer of fine resolution coupled ocean models to massively parallel machines; visualization techniques for increasingly large global data sets; and advanced communication systems for near real time data transfer between research institutions, sensing systems and ships.

- $60.53 million for individual and group research activities in other ocean sciences areas including physical, chemical, geological, biological and ocean technology projects. Coastal oceanographic studies, expanded effort in environmental research, and modest increases in instrumentation and technical development areas will be accomplished within existing budget levels.

- $31.55 million for general ship operations, maintenance, and coordination functions to support the research projects funded by the Ocean Sciences Subactivity and other NSF research programs. With additional ship operations funds specifically linked to the USGCRP, operations support for 26 ships of the academic research fleet totals $52.55. NSF support for global change field programs and general studies provides about 70 percent of all academic ship operations. The balance is provided through other federal agencies and academic institutions.

- $40.00 million, including an increase of $1.32 million, for ongoing research and operations requirements of the Ocean Drilling Program (ODP). The increase, redirected from other activities in the Ocean Sciences Subactivity, will maintain the current level of effort for the program as operating costs increase. Research will focus on the Atlantic Ocean and Mediterranean Sea. Specific topics include sampling for climatic studies of the North Atlantic, geologic history and tectonics of the Mediterranean region, and evolution and formation of oceanic crust and associated hydrothermal systems.

- $2.80 million for support of educational and human resources programs including undergraduate research, postdoctoral fellowships, activities for underrepresented minorities, and special programs for research and teaching by young faculty.

Number of People Involved in OCE Activities

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Senior Researchers	1,150	1,165	1,165
Other Professionals	1,080	1,090	1,100
Post-Doctorates	100	110	120
Graduate Students	550	550	550
Undergraduate Students	230	240	250
Total Number of People	3,110	3,155	3,185

MATHEMATICAL AND PHYSICAL SCIENCES $657,720,000

The FY 1995 Budget Request for the Mathematical and Physical Sciences (MPS) Activity is $657.72 million, an increase of $37.87 million, or 6.1 percent, over the FY 1994 Current Plan of $619.85 million.

(Millions of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Change Amount	Change Percent
Mathematical Sciences	77.62	82.21	88.71	6.50	7.9%
Astronomical Sciences	103.19	106.42	111.92	5.50	5.2%
Physics	128.28	133.73	141.73	8.00	6.0%
Chemistry	112.26	121.40	129.90	8.50	7.0%
Materials Research	164.51	176.09	185.46	9.37	5.3%
TOTAL, MPS	$585.86	$619.85	$657.72	$37.87	6.1%

The MPS Activity supports a broad range of research and education activities in astronomical sciences, chemistry, materials research, mathematical sciences, and physics. In most of these areas, MPS provides approximately 50 percent of all federal support for basic research in academic institutions (ranging from approximately 30 percent to close to 100 percent depending on subfield). MPS maintains close connections with other agencies, other disciplines, and industry to enhance the impact, relevance and leverage of its funding to the extent possible.

MPS support for experimentation, observation, computational analysis, theoretical explorations, and education and human resource development leads to:

- **New knowledge at the frontiers of mathematical and physical sciences.** The Nobel Prize in Physics for 1993 was awarded to Joseph Taylor and Russell Hulse of Princeton University for their discovery of the first binary pulsar and for subsequent studies over a twenty year period leading to high precision tests of Einstein's theory of gravitation. Their observation and analysis of signals obtained through the Arecibo radio telescope allowed them to verify a very slight inward spiraling of the binary pair that causes their mutual orbit to speed up and contract in size as predicted by Einstein.

- **Innovation in ideas and approaches to foster scientific progress and enhance its application in technology.** In order to exploit the new science of cooling and manipulating atoms with strong beams of laser light and to move the basic science into usable technologies, MPS is supporting a multi-institutional "center without walls" in light force dynamics. It brings basic researchers working on the most fundamental questions of light-matter interaction together with industrial scientists and engineers seeking new techniques and products for the electro-optics and optical communications communities.

- **Education for the scientists, engineers and citizenry of tomorrow to meet the needs of the nation.** Scientists at the Science and Technology Center (STC) at the University of Texas (with funding provided by both MPS and the Education and Human Resources Activity) have adopted a largely Hispanic class at the Zavala Elementary School in Austin. Faculty members and students from the STC assist the "Zavala Young Scientists" with hands-on activities, providing materials and demonstrations, bringing children into the STC research laboratories, and helping with science fair projects.

- **Participation by scientists and engineers in the solution of broad national problems with scientific components.** The research of Alberto Grunbaum at the University of California at Berkeley centers around inverse problems arising in biomedical imaging. He is exploring ways in which developments in mathematical physics yield insights in diffuse tomography, which has applications to medical imaging using very low energy probes (such as infra-red lasers) that are particularly valuable in mammography and neonatal diagnostics. The mathematical formulations lead to a fully nonlinear problem whose resolution requires new ideas from several areas of mathematics. The ideas also have applicability in areas such as crystallography, radar target estimation and semiconductors.

In its planning for FY 1995, MPS has identified five areas where conditions are ripe for substantive scientific progress: materials, environment, computation, links to the biosciences and nonlinear science. Each Subactivity within MPS touches on these areas in some way, such as taking them as tools for advancing the discipline, or contributing new disciplinary knowledge and tools to their development. These five areas have a broad intersection with areas of strategic importance identified in NSF and interagency initiatives. At the same time MPS reiterated the importance of attention to physical and human infrastructure in ensuring that its programs continue to be effective in both the short and long term.

The FY 1995 Request for MPS will permit the Activity to make progress toward meeting its goals and sustaining its priorities. MPS will hold constant the number of awards, senior investigators and graduate students so that investment in funded activities is sufficient for scientific and educational progress.

Research in Strategic Areas

Examples of research in strategic areas include:

(Millions of Dollars)

	FY 1994 Estimate	FY 1995 Estimate	Percent Change
Advanced Manufacturing Technology	44.80	48.97	9.3%
Advanced Materials & Processing Program	200.40	202.50	1.0%
Biotechnology	16.70	18.80	12.6%
Civil Infrastructure Systems	11.60	12.60	8.6%
Environmental Research	11.70	18.70	59.8%
High Performance Computing & Communications	15.15	25.35	67.3%
Science, Math, Engineering & Technology Education	29.47	35.17	19.3%
U.S. Global Change Research Program	1.81	5.51	204.4%

Note: Projects which have strong connections to the goals and objectives of more than one initiative are difficult to attribute to single initiative. In an effort to present a more precise measure of its research and education initiatives, NSF will redefine its internal data collection and analysis capabilities so that the allocation of resources for these initiatives can be shown in a mutually exclusive manner.

Many of these initiatives overlap in substance with the others, either arising from common intellectual bases or benefiting from similar theoretical, computational, or instrumentation advances. Recurring themes include materials synthesis and processing, particularly environmentally benign synthesis and processing, and modeling and simulation for predictive purposes.

In each initiative, MPS support has multiple goals: accelerating the expansion of knowledge within the strategic area; bringing the power of MPS disciplines to bear on the strategic areas by articulating the ties to MPS research frontiers and engaging MPS researchers in addressing them; disseminating results among and beyond MPS researchers; and ensuring a base of trained personnel conversant with the issues and capable of addressing them. MPS is the focal point for advanced materials at NSF, but the focus of the other strategic initiatives lies outside MPS disciplines. Thus, engaging MPS researchers and disseminating results beyond traditional MPS communities are particularly important.

The FY 1995 Budget Request includes:

- Research and education activities in the **Advanced Materials and Processing Program** (AMPP) total $202.50 million in FY 1995, an increase of $2.10 million over the FY 1994 total of $200.40 million. Ongoing activities in all MPS Subactivities emphasize synthesis and processing; theory, modeling and simulation; materials characterization; and education and training in materials. The Materials Research Subactivity lies at the core of this initiative and has led the development of a multidisciplinary approach.

  Centers and national user facilities play a particularly important role in this initiative. The Materials Research Science and Engineering Centers provide a focus for multidisciplinary research in materials. They are complemented by Science and Technology Centers in the Chemistry and Physics Subactivities. The National High Magnetic Field Laboratory at Florida State University, the Cornell Electron Storage Ring and its companion Cornell High Energy Synchrotron Source, and the new National Nanofabrication User Facilities Network are major resources for AMPP.

  Recently there have been startling breakthroughs in the modeling and understanding of the internal structures of materials and crystallization processes using techniques of differential geometry. Studies of higher order symmetries have given rise to new findings in molecular chemistry. The coupling of new breakthroughs in the theory of area-minimizing surfaces together with advanced computer graphics simulation has led to a deeper understanding and more precise modeling of the microstructure of compound polymers.

  The increase of $2.10 million in FY 1995 will strengthen efforts in research and education. A major emphasis of activities in AMPP will be tying the results of this initiative to others, particularly Advanced Manufacturing Technology. Incremental funds for these efforts are assigned to the relevant other initiative.

- Research in **Advanced Manufacturing Technology** totals $48.97 million in FY 1995, an increase of $4.17 million above the FY 1994 level of $44.80 million. Ongoing activities include research supported through all MPS Subactivities focused on synthesis and processing, particularly in the chemical, pharmaceutical, and electronics industries. Much of this activity grows out of earlier emphases on materials synthesis and processing and environmentally benign synthesis and processing. Modeling and simulation of processes is another important component.

  An interdisciplinary group at the University of California at San Diego discovered novel alloys of nickel and cobalt oxides. Magnetic reading and recording heads using these alloys can be made smaller, more sensitive, and able to read and record at higher density and rate.

  The increase of $4.17 million in FY 1995 will strengthen and expand research in synthesis and processing, predominately in the Chemistry and Materials Research Subactivities.

- **Environmental Research** totals $18.70 million in FY 1995, an increase of $7.00 million over the FY 1994 total of $11.70 million. Ongoing activities include research supported primarily through the Chemistry and Materials Research Subactivities. This research grows out of efforts in environmentally benign synthesis and processing, undertaken in cooperation with the Engineering Activity.

  Dr. Wayne L. Gladfelter of the Chemistry Department of the University of Minnesota, in collaboration with Catalytica, Inc., has developed a new route to isocyanates. The method bypasses the use of phosgene, a highly toxic gas. About 1.7 billion pounds of isocyanates are produced annually in the U.S. for use in the production of polyurethanes, a common insulation material.

  The increase of $7.00 million in FY 1995 will make Environmental Research and the related Global Change area the fastest-growing in MPS. There will be particular emphasis on enhancing industry-academic interactions. Close coordination between NSF and other agencies will be accomplished through existing memoranda of understanding (with EPA and NIST) and new memoranda of understanding. A component of modeling and simulation, particularly in mathematical ecology, will complement the focus on synthesis and processing.

- Research in the **U.S. Global Change Research Program** totals $5.51 million in FY 1995, an increase of $3.70 million over the FY 1994 level of $1.81 million. Ongoing activities include research and instrumentation supported through the Astronomical Sciences, Chemistry and Mathematical Sciences Subactivities. A significant effort aims at bringing enhanced mathematical and statistical techniques to the modeling and simulation of global climate change. Other activities include development of advanced instrumentation for addressing the influences of solar radiation and research focused on climatic influences of greenhouse gases.

  The increase of $3.70 million in FY 1995 will support additional activities including modeling and simulation of atmospheric plasma flows in the Physics Subactivity and developing methods for integrated assessment of global change data in the Mathematical Sciences Subactivity.

- Research in **High Performance Computing and Communications** (HPCC) totals $25.35 million in FY 1995, an increase of $10.20 million over the FY 1994 level of $15.15 million. Ongoing activities include research and education supported through all MPS Subactivities in all components of the original HPCC initiative and in the **Information Infrastructure Technology and Applications** (IITA) component. Projects supported jointly with other Activities through the HPCC Grand Challenge Applications Groups are particularly important to enabling MPS researchers to support the goal of sustained teraflop computation for significant scientific problems.

  For example, massively parallel computers will soon allow chemists to design, characterize and optimize new drugs and other new materials before beginning the expensive process of synthesis, processing and testing in the laboratory. Substantial extensions of the range of electronic structure calculations have been achieved already by Columbia University's Richard Friesner and California Institute of Technology's William Goddard with their Pseudospectral Generalized Valence Bond method. Goddard has also developed algorithms for molecular dynamics simulations on systems of several million atoms.

  The increase of $10.20 million in FY 1995 will strengthen research in all HPCC areas, with an emphasis on IITA. MPS will develop a coordinated effort for remote observation and experimentation; development of, access to, and transmission of large, complex databases; and development of specialized electronic libraries.

- Research in **Biotechnology** totals $18.80 million in FY 1995, an increase of $2.10 million over the FY 1994 level of $16.70 million. Ongoing research is supported through the Chemistry, Materials Research, Mathematical Sciences and Physics Subactivities. Most are supported through standard research projects, with complementary activities found as components of centers, and some aspects supported through user facilities.

  An interdisciplinary group of physicists and materials scientists at the University of California at Santa Barbara, in collaboration with colleagues from Exxon Research and Engineering and the Physics and Physiology Departments at Boston University, have succeeded in stabilizing the membrane-protein bacteriorhodopsin in the form of a self-assembled, multi-layered two-dimensional lattice at temperatures as high as 140 degrees Centigrade. The new approach holds promise for eventual use in technological applications as diverse as molecular electronics and optical switching, molecular sieves, and the lithographic fabrication of nanometer-scale patterns.

  The increase of $2.10 million in FY 1995 will focus on novel approaches to materials synthesis, biomimetic chemicals and materials and biomolecular materials.

- Research in **Civil Infrastructure Systems** totals $12.60 million in FY 1995, an increase of $1.00 million over the FY 1994 level of $11.60 million. Ongoing activities in the Materials Research and Mathematical Sciences Subactivities include support for surface engineering design to enhance the resistance of materials to environmental degradation and to promote long component life and reliability, and modeling and simulation efforts for predictive purposes.

  The Science and Technology Center for Advanced Cement-Based Materials at Northwestern University conducts research on the chemistry and physics of cementitious materials as well as on processing science, microstructural analysis, material properties, fracture toughness, and fiber reinforcement. Its integrated approach will enable a more efficient use of cement-based materials for rehabilitation of infrastructure, manufactured building components, waste-disposal systems, and heat- and abrasion-resistant parts for tools and electronic devices.

The increase of $1.00 million in FY 1995 will enhance research in these areas.

- Funding for efforts in **Science, Mathematics, Engineering and Technology Education** (SMETE), supported through all MPS Subactivities, totals $35.17 million in FY 1995, an increase of $5.70 million over the FY 1994 level of $29.47 million. The principal focus is undergraduate education, including Research Experiences for Undergraduates, Research at Undergraduate Institutions, Research Opportunity Awards, and Course and Curriculum Development. Postdoctoral fellowship programs form the second large category of activity, including an industrial research option in the Mathematical Sciences Subactivity for the first time in FY 1994.

  The increase of $5.70 million in FY 1995 will strengthen activities at the undergraduate level and permit expansion of cooperative postdoctoral fellowships with industry across all MPS Subactivities.

Modes of Support

MPS supports its ongoing and new activities through the following modes:

(Millions of Dollars)

	FY 1994 Estimate	FY 1995 Estimate	Percent Change
Research Projects	378.42	401.32	6.1%
Centers	65.96	66.81	1.3%
Facilities	128.98	136.78	6.0%
Education & Training	46.49	52.81	13.6%
Total, MPS	$619.85	$657.72	6.1%

Research Projects

Research Projects range from very small awards supporting a single individual investigator to large awards that provide for the research needs of many investigators working on a variety of single- or multiple-investigator projects. These projects include the development and acquisition of equipment, a particularly important component of MPS activity.

Funding for research projects totals $401.32 million in FY 1995, an increase of $22.90 million over FY 1994. This is nearly 60 percent of the MPS total. Funding is mixed between projects supporting the objectives of interagency initiatives and other research projects. Examples of results stemming from these research projects include:

- One of the greatest challenges for the chemist is the design of molecules and methodologies that mimic nature. Particularly exciting developments are the "chemzymes" of Harvard University's E. J. Corey, small molecules with catalytic activities rivaling those of enzymes, and the self-replicating molecules designed by the Massachusetts Institute of Technology's Julius Rebek, taking lessons from DNA.
- The development phase of a laser guide-star adaptive optical system is currently being carried out by the University of Illinois at the Mount Wilson Observatory. When completed, this system, based on technology transferred from the Department of Defense, promises to open a new window on the universe.

The increase of $22.90 million in FY 1995 will strengthen research projects with emphasis on Global Change, HPCC, and Advanced Manufacturing Technology. MPS will also emphasize enhanced research in nonlinear science, focusing on understanding fundamental phenomena in Physics and Mathematical Sciences.

Centers

MPS-supported centers include Science and Technology Centers (STCs) and Materials Research Science and Engineering Centers (MRSECs).

(Millions of Dollars)

	FY 1994 Estimate	FY 1995 Estimate	Percent Change
Science and Technology Centers	24.36	24.71	1.4%
Materials Research Science & Engineering Centers	41.60	42.10	1.2%
Total Center Support, MPS	$65.96	$66.81	1.3%
Number of Researchers	1,330	1,355	1.9%
Number of Students	1,840	1,860	1.1%

Centers serve as a natural vehicle for educational activities and for outreach to other institutions or to industry. MPS has taken advantage of this characteristic by providing supplemental support to several STCs to create linkages with minority institutions with the goal of enhancing diversity in the MPS community.

All STCs have been established for at least three years, and exciting results coming from them include:

- In a joint program with several organizations, the Center for Particle Astrophysics at the University of California at Berkeley has found evidence of dark, Jupiter-sized masses in the halo of our galaxy. The observation of these masses, which would be a component of the missing "dark matter" in the universe, was made possible by the development of a large format electronic camera and sophisticated data processing facilities.

- The University of Michigan Center for Ultrafast Optical Science performs basic research and technological development in ultrafast optical science, ultrafast material science, high-field science, and ultrafast and high-field technology. In the first three years of operation, the Center has spawned affiliations with thirteen companies and has helped to bring ten new products to market (with sixteen others under development). The Center is now poised to launch the Ultrafast Development Laboratory where scientists and engineers from private companies will conduct experiments related to product development along with Center students.

MRSECs combine the Materials Research Groups (MRGs), Materials Research Laboratories (MRLs) and the STCs operated by the Materials Research Subactivity. Highlights from the MRSECs include:

- Electrical engineers, materials scientists, and physicists at the MRG at Purdue University and the University of Notre Dame have produced blue-green diode lasers with continuous wave laser operation at "room temperature." The lasers are needed for flat panel color displays, e.g., color television, radar screens, computer monitors. They are also of great potential importance in optical communications and vision systems.

- In the course of investigations into the fundamental properties of gels -- cross-linked polymer networks filled with water or other solvents -- at the Massachusetts Institute of Technology MRL, a member of the Physics Department discovered that a gel can suddenly change its volume by a factor of more than one thousand. This enormous change can be triggered by slight variations in factors such as temperature, solvent composition, pH, ionic composition, electric field, or light. Furthermore, the change is reversible. These discoveries have opened the door to applications for gels in the chemical, agricultural and medical industries. Patents from the work provided the founding technology for two new companies, and a number of large corporations are also using the new gel-based technologies.

Facilities

MPS supports world class national user facilities necessary for the conduct of research. NSF support provides for ongoing operations and maintenance, including upgrades to existing facilities as well as regularly scheduled repair.

(Millions of Dollars)

	FY 1994 Estimate	FY 1995 Estimate	Percent Change
National High Magnetic Field Lab	12.00	12.00	0.0%
National Radio Astronomy Observatory	29.34	30.94	5.5%
National Optical Astronomy Observatories	27.49	28.79	4.7%
National Astronomy & Ionosphere Center	8.60	9.00	4.7%
Indiana University Cyclotron Facility	8.30	8.80	6.0%
Cornell Electron Storage Ring	18.00	20.00	11.1%
National Superconducting Cyclotron Lab	9.20	9.20	0.0%
Materials Research Facilities	16.05	18.05	12.5%
Total Facilities Support, MPS	$128.98	$136.78	6.0%
Number of Researchers	1,740	1,830	5.2%
Number of Students	450	475	5.6%

- Support for the Cornell Electron Storage Ring (CESR) will increase by $2.00 million to a total of $20.00 million. The increment will support a continuing upgrade to the facility to increase its luminosity. CESR has been in operation since the mid-1970s. In FY 1994, approximately 120 researchers and students will use the facility and its principal detector for work in elementary particle physics. Another 500 researchers and students will use the related Cornell High Energy Synchrotron Source (CHESS) facility for materials research and biology activities requiring a source of synchrotron radiation. The luminosity upgrade will enhance the capabilities of all users.

- Funding for the National Astronomy and Ionosphere Center (NAIC), the National Optical Astronomy Observatories (NOAO), and the National Radio Astronomy Observatory (NRAO), the three major national facilities in astronomy, will increase by $3.30 million to a total of $68.73 million. The increment will support operations and maintenance at the observatories, development of instrumentation that takes advantage of their capabilities, and enhanced operations of the Very Long Baseline Array (VLBA) at NRAO. It will also permit all facilities to participate more fully and directly in the High Performance Computing and Communications effort, particularly the Information Infrastructure Technology and Applications component. The funding provides direct support for over 200 researchers, technicians and students.

- Funding for the National High Magnetic Field Laboratory (NHMFL) at Florida State University will remain constant at $12.00 million, with funds shifting from capital investment to operations as the laboratory moves toward full operation in 1998. Construction of the laboratory was initiated in FY

1991 in a partnership with the state of Florida. NHMFL began operations in 1993 with over 100 users; that number is expected to increase by a factor of four by 1995.

- The Indiana University Cyclotron Facility (IUCF) and Michigan State University's National Superconducting Cyclotron Laboratory (NSCL) support research activities in nuclear physics. Each serves approximately 200 researchers and students on an annual basis. An increment of $500,000 in FY 1995 to a total of $18.00 million is focused on IUCF to bring new instrumentation on line.

- Materials Research facilities include: CHESS, the University of Wisconsin's Synchrotron Research Center, the Francis Bitter Magnet Lab at MIT, the Institute for Theoretical Physics, Arizona State University's Center for High Resolution Electron Microscopy, the Center for High Resolution Neutron Scattering at NIST, and the National Nanofabrication User Facility Network (joint with the Engineering and Biosciences Activities). An FY 1995 increment of $2.00 million will be used for upgrades to the facilities where needed to keep them at the cutting edge and to provide researchers with instrumentation at the national synchrotron facilities.

- Two additional facilities which will benefit the MPS disciplines, the Laser Interferometer Gravitational Wave Observatory (LIGO) and the Gemini telescopes, are currently under construction. See the Major Research Equipment Account for further information.

Education and Training

MPS places a high priority on programs for Education and Training, both to maintain the future supply of scientists and engineers and to develop a scientifically and technologically literate populace.

(Millions of Dollars)

	FY 1994 Estimate	FY 1995 Estimate	Percent Change
Undergraduate	23.93	27.73	15.9%
Graduate	0.00	0.00	0.00
Postdoctoral	5.54	7.44	34.3%
Other	17.02	17.64	3.6%
Total Education & Training, MPS	$46.49	$52.81	13.6%

Most of the activities aimed directly at education and training are included in the interagency accounting for the Science, Mathematics, Engineering and Technology Education (SMETE) initiative where the MPS focus is at the undergraduate level.

- MPS supports more than 100 Research Experiences for Undergraduate (REU) sites and more than 1,000 undergraduate students in the mixture of sites and supplements to research awards. These activities provide students with an understanding of what it means to conduct research. Participation by women and underrepresented minorities in REU sites is significant, making the REU sites an important tool for enhancing diversity in the MPS community. Funding for REU activities will increase $1.65 million in FY 1995 to a total of $12.70 million.

- Research Opportunity Awards (ROA) and Research at Undergraduate Institutions (RUI) will increase by $1.12 million in FY 1995 to a total of $10.42 million. These programs assist faculty at undergraduate institutions to build and maintain research programs, connecting them to the cutting edge of research activity.

- Course and Curriculum Development is particularly important in MPS disciplines because of the many fields of science and engineering that depend on training in them. Activities within MPS are closely coordinated with those of the Education and Human Resources Activity. An increment of $730,000 in FY 1995 for a total of $3.31 million will enhance these coordinated efforts.

- Other undergraduate activities in these categories include special mentorship activities for underrepresented groups and integrating activities that bring undergraduate and graduate students, undergraduate faculty, high school teachers and research faculty into a common environment. An increment of $300,000 in FY 1995 to a total of $1.30 million is focused in the Mathematical Sciences Subactivity.

MPS also has active postdoctoral fellowship programs that form a significant component of the SMETE initiative.

- An increment of $1.90 million in FY 1995 to a total of $7.44 million will expand existing postdoctoral fellowship opportunities for research experiences in industry to all MPS Subactivities.

Other components of Education and Training are not included in the SMETE initiative.

- Support for the career development of young investigators receives an increment of $620,000 in FY 1995 for a total of $17.64 million. Enhancing the diversity of the MPS community will receive some emphasis within this total.

Number of People Involved in MPS Activities

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Senior Researchers	5,670	5,730	5,730
Other Professionals	1,290	1,310	1,380
Post-Doctorates	1,780	1,860	2,040
Graduate Students	5,630	5,700	5,700
Undergraduate Students	2,090	2,160	2,270
Total Number of People	16,460	16,760	17,120

MPS Funding Profile

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Total Number of Awards	4,406	4,453	4,450
Statistics for Competitive Awards:			
Number	1,779	1,780	1,780
Funding Rate	38%	35%	32%
Median Annualized Award Size	$55,000	$58,000	$60,000
Average Annualized Award Size	$86,935	$92,000	$96,000
Average Duration (yrs.) \1	2.9	3.0	3.0

1\ Average Duration includes research projects only.

MATHEMATICAL SCIENCES $88,710,000

The FY 1995 Budget Request for the Mathematical Sciences (DMS) Subactivity is $88.71 million, an increase of $6.50 million, or 7.9 percent, over the FY 1994 Current Plan of $82.21 million.

(Millions of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Change Amount	Change Percent
Disciplinary Research	45.13	46.64	49.00	2.36	5.1%
Cross-Disciplinary and Computational Research	15.77	17.37	20.01	2.64	15.2%
Special Projects	16.72	18.20	19.70	1.50	8.2%
Total, DMS	$77.62	$82.21	$88.71	$6.50	7.9%

NSF plays a crucial role in the support of academic research in the mathematical sciences, providing approximately 50 percent of all federal support. In all areas of the mathematical sciences, Foundation-supported research involves a broader range of infrastructure, basic research, and cross-disciplinary research topics than those sponsored by the mission agencies.

Ongoing research activities within Disciplinary Research include areas such as classical analysis, modem analysis, geometric analysis, topology, foundations, algebra and number theory. Activities within the Cross-Disciplinary and Computational Research program element include applied mathematics, statistics and probability, and computational mathematics. Awards through these program elements support basic and cross-disciplinary research in the mathematical sciences, with grants usually including funding for graduate and postdoctoral students as well as computing equipment and other research needs. The Science and Technology Center for Computation and Visualization of Geometric Structures at the University of Minnesota (the "Geometry Center") is supported within the Cross-Disciplinary and Computational Research program element.

The Special Projects program supports various efforts that cut across the mathematical sciences, including: research institutes; postdoctoral research fellowships; research conferences, workshops, and special years; shared scientific computing research equipment; and undergraduate programs managed in collaboration with the Education and Human Resources Activity.

The FY 1995 Budget Request includes increases that will continue to support the participation of the mathematical sciences in a variety of interagency, NSF, and MPS initiatives. They reflect both the importance of mathematical modeling, simulation, control, visualization, and algorithm development, and the readiness of the mathematical sciences to enhance research in these areas. The problems of science are framed in the language of the mathematical sciences; thus, the mathematical sciences as both the modeling tool and the language of science is continually challenged to develop new constructs that expand capabilities.

- Disciplinary Research increases by $2.36 million in FY 1995 to a total of $49.00 million. Enhancing capabilities in nonlinear science and participation in the **High Performance Computing and Communications** initiative are high priorities.

- Cross-Disciplinary and Computational Research increases by $2.64 million to a total of $20.01 million. Increases are for enhanced participation in **Global Change, High Performance Computing and Communications, Advanced Manufacturing Technology** and **Civil Infrastructure Systems.**

- An increment of $1.50 million for Special Projects to a total of $19.70 million will enhance activities in education, with emphasis on Research Experiences for Undergraduates sites and postdoctoral fellowships.

Number of People Involved in DMS Activities

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Senior Researchers	1,490	1,500	1,500
Other Professionals	50	50	50
Post-Doctorates	220	240	250
Graduate Students	880	940	950
Undergraduate Students	100	100	110
Total Number of People	2,740	2,830	2,860

ASTRONOMICAL SCIENCES $111,920,00

The FY 1995 Budget Request for the Astronomical Sciences (AST) Subactivity is $111.92 million, an increase of $5.50 million, or 5.2 percent, over the FY 1994 Current Plan of $106.42 million.

(Millions of Dollars)

Program Element	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Change Amount	Change Percent
Astronomy Research Project Support	36.09	40.99	43.19	2.20	5.4%
National Astronomy and Ionosphere Center	9.69	8.60	9.00	0.40	4.7%
National Optical Astronomy Observatories	27.60	27.49	28.79	1.30	4.7%
National Radio Astronomy Observatory	29.81	29.34	30.94	1.60	5.5%
Total, AST	$103.19	$106.42	$111.92	$5.50	5.2%

NSF is the lead federal agency for ground-based astronomy, providing about two-thirds of the federal support for this area of science.

Ongoing research activities within Research Project Support cover areas such as planetary astronomy, stellar astronomy and astrophysics, galactic astronomy, extragalactic astronomy and cosmology, and advanced technologies and instrumentation. Human resource development, special projects, and a science and technology center are also located in this program element. Awards support basic research in the field of astronomy and astrophysics, with grants usually including funding for graduate and postdoctoral students as well as instrumentation and other research needs. Electromagnetic Spectrum Management, which provides coordination with government agencies of electromagnetic spectrum use for research and frequency assignments for other telecommunications/electronics systems, is also found in Research Project Support.

Facilities supported by the Astronomical Sciences Subactivity include the National Astronomy and Ionosphere Center (NAIC), the National Optical Astronomy Observatories (NOAO), and the National Radio Astronomy Observatory (NRAO). These national centers provide observing capability in radio and optical/infrared regimes of the spectrum.

The FY 1995 Budget Request includes:

- $2.20 million increase for Research Project Support to a total of $43.19 million. This will provide for continued development of adaptive optics systems for moderate aperture telescopes, for development of optical interferometers and for developing enhanced interactions between the academic and industrial sectors through postdoctoral fellowships.

- $400,000 increase for NAIC to a total of $9.00 million. This will provide for development of instrumentation to take advantage of the capabilities of the upgraded Arecibo Telescope.

- $1.30 million increase for NOAO to a total of $28.79 million. The increases are for operations and maintenance of the observatories, with particular emphasis on infrastructure support, including instrumentation development and deployment for exploration of solar influences in **Global Change**.

- $1.60 million increase for NRAO to a total of $30.94 million. The increases are for operations and maintenance of existing telescopes, for instrumentation, and for enhanced operations of the Very Long Baseline Array (VLBA).

Enhanced support for transfer of data obtained at the national centers and for remote control of observations will be part of Astronomical Sciences participation in the **High Performance Computing and Communications** initiative.

The table below provides more detail for the National Centers.

(Millions of Dollars)

	FY1994 Estimate	FY 1995 Estimate
National Astronomy and Ionosphere Center		
Scientific Research Support*	8.02	8.82
Arecibo Upgrade	2.52	0.77
Less NASA Support	1.94	0.59
TOTAL, NAIC	**$8.60**	**$9.00**
National Optical Astronomy Observatories		
Scientific Research Support*	27.67	28.98
[Kitt Peak National Observatory	8.73	9.14
[Cerro Tololo Inter-American Observatory	6.64	6.95
[National Solar Observatory	5.69	5.96
Management Fee	0.43	0.45
Less DoD Support	0.61	0.64
TOTAL, NOAO	**$27.49**	**$28.79**
National Radio Astronomy Observatory		
Scientific Research Support*	28.72	30.29
Management Fee	0.62	0.65
TOTAL, NRAO	**$29.34**	**$30.94**

* Includes funds for operations and maintenance

Number of People Involved in AST Activities

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Senior Researchers	550	570	570
Other Professionals	620	630	670
Post-Doctorates	70	70	70
Graduate Students	240	250	270
Undergraduate Students	20	30	30
Total Number of People	1,500	1,550	1,610

PHYSICS $141,730,000

The FY 1995 Budget Request for the Physics (PHY) Subactivity is $141.73 million, an increase of $8.00 million, or 6.0 percent, over the FY 1994 Current Plan of $133.73 million.

(Millions of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Change Amount	Change Percent
Physics Research Project Support	96.18	98.23	103.73	5.50	5.6%
Facilities	32.10	35.50	38.00	2.50	7.0%
Total, PHY	$128.28	$133.73	$141.73	$8.00	6.0%

The Physics Subactivity supports research across the range of physics, including support for both disciplinary and interdisciplinary activities.

Ongoing research activities within Physics Research Project Support cover areas such as elementary particle, nuclear, atomic, molecular, optical, gravitational and theoretical physics. Awards support basic research in these physics fields, with grants usually including funding for graduate and postdoctoral students as well as instrumentation and other research needs. In addition to supporting research by individuals and small groups, the program supports experiments by large user groups at national and international facilities and activities of large and small university-based accelerator centers whose facilities serve a national community of users, not only in physics, but also in materials research, biology, geology, oceanography and medical technology. The Science and Technology Center for Ultrafast Optics (where the development of new ultra-high-power lasers has led to new technologies of importance to communications and computing) is also found in this program element, as are activities for undergraduate students, faculty and curriculum development.

Facilities supported by the Physics Subactivity include the Cornell Electron Storage Ring (CESR), the Indiana University Cyclotron Facility (IUCF) and the Michigan State University National Superconducting Cyclotron Laboratory (NSCL). Each of these NSF facilities is unique in its capabilities and provides services unavailable at other laboratories in the U.S. The significant role of NSF in supporting accelerator development activities is evident in recent successes at these centers, including important advances in the uses of superconducting technologies, the study of nonlinear dynamics, and the development of new radiological treatments of disease.

The FY 1995 Budget Request includes:

- An increment of $5.50 million for Physics Research Project Support to a total of $103.73 million. This includes significantly increased support for **High Performance Computing and Communications**, non-linear physics, **Advanced Manufacturing Technology**, **Advanced Materials Processing Program**, and new research in biophysics and particle astrophysics. Activities in undergraduate education and curriculum development will also receive enhancements.

- An increment of $2.50 million for Facilities to a total of $38.00 million. The major portion of this increment will continue an upgrade of CESR to luminosities a factor of at least 30 higher than exist anywhere in the world at similar facilities, making possible advanced research in particle physics and with synchrotron light.

Number of People Involved in PHY Activities

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Senior Researchers	1,080	1,080	1,080
Other Professionals	300	300	320
Post-Doctorates	500	500	560
Graduate Students	1,000	1,000	1,010
Undergraduate Students	670	700	750
Total Number of People	3,550	3,580	3,720

CHANGES IN BUDGET STRUCTURE

The Physics Subactivity has been restructured into two program elements to simplify the budgetary presentation. The Facilities Program Element includes major, university-based accelerator facilities at Cornell University, at Michigan State University, and at Indiana University. A crosswalk of the FY 1994 Current Plan for this new presentation is shown below.

(Millions of Dollars)

	New Program Elements		
Old Program Elements	Research Project Support	Facilities	Total, Old Structure
Elementary Particle Physics	25.43	18.00	$43.43
Nuclear Sciences	23.16	17.50	$40.66
Atomic, Molecular, and Optical Physics	19.47		$19.47
Theoretical Physics	19.39		$19.39
Gravitational Physics	10.78		$10.78
Total, New Structure	$98.23	$35.50	$133.73

CHEMISTRY $129,900,00

The FY 1995 Budget Request for the Chemistry (CHE) Subactivity is $129.90 million, an increase of $8.50 million, or 7.0 percent, over the FY 1994 Current Plan of $121.40 million.

(Millions of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Change Amount	Change Percent
Chemistry Research Project Support	95.53	102.90	109.43	6.53	6.3%
Instrumentation and Infrastructure	16.73	18.50	20.47	1.97	10.6%
Total, CHE	$112.26	$121.40	$129.90	$8.50	7.0%

The Chemistry Subactivity supports research across a broad range of chemistry, including purely disciplinary as well as interdisciplinary activities with biology, materials science and chemical engineering.

Ongoing research activities within Research Project Support cover areas such as analytical, surface, physical, organic, macromolecular, inorganic, bioinorganic, and organometallic chemistry as well as support for interdisciplinary materials chemistry projects. These programs all support basic research in chemistry, with grants usually including funding for graduate and postdoctoral students as well as for instrumentation and other research needs.

Instrumentation and Infrastructure includes support for Science and Technology Centers (STCs) at the University of Rochester (involving Kodak and Xerox) and the University of Texas, major instrumentation for shared use in chemistry departments, Research Experience for Undergraduates sites, and the Chemistry Postdoctoral Fellowship Program.

The FY 1995 Budget Request includes:

- An increment of $6.53 million for Chemistry Research Project Support for a total of $109.43 million. The increment includes strengthening research in the **Environmental Research, Advanced Materials and Processing, Advanced Manufacturing Technologies, High Performance Computing and Communications, U.S. Global Change Research Program, and Biotechnology** initiatives. Research in environmental chemistry will grow most rapidly, with an increase of $5.00 million in FY 1995 to support research underpinning environmentally benign chemical manufacturing as well as the development of experimental and computational methodologies and the data base needed to predict the fate of new chemicals in the environment. Memoranda of understanding with EPA and NIST will be used in cooperating with those agencies in the Environmental Research efforts.

- An increment of $1.97 million for Instrumentation and Infrastructure for a total of $20.47 million. The increment includes additional activity in **Science, Mathematics, Engineering and Technology Education** to enhance REU efforts as well as to initiate postdoctoral fellowships and research opportunity awards for research in industrial laboratories to acquaint researchers with real-world environmental problems. Also included is additional funding for instrumentation to be used for beam line instrumentation at the Advanced Photon Source.

Number of People Involved in CHE Activities

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Senior Researchers	1,030	1,040	1,040
Other Professionals	40	50	50
Post-Doctorates	520	550	600
Graduate Students	1,590	1,690	1,750
Undergraduate Students	910	920	950
Total Number of People	4,090	4,250	4,390

CHANGES IN BUDGET STRUCTURE

The Chemistry Subactivity has been restructured into two program elements to simplify the budgetary presentation. Research Project Support includes all individual and group research projects, including those within the interagency initiatives. Instrumentation and Infrastructure includes awards supporting shared instrumentation facilities, two Science and Technology Centers, and Human Resource Development programs, including Research Experiences for Undergraduates and Postdoctoral Fellowships. A Crosswalk of the FY 1994 Current Plan for the new organization is shown below.

(Millions of Dollars)

	New Program Elements		Total,
Old Program Elements	Research Project Support	Instrumentation & Infrastructure	Old Structure
Chemical Instrumentation		8.33	$8.33
Organic and Macromolecular Chemistry	28.66		$28.66
Physical Chemisty	35.27		$35.27
Inorganic, Bioinorganic and Organomettalic Chemistry	18.61		$18.61
Analytical and Surface Chemistry	15.19		$15.19
Special Projects	5.17	10.17	$15.34
Total, New Structure	$102.90	$18.50	$121.40

MATERIALS RESEARCH $185,460,000

The FY 1995 Budget Request for the Materials Research (DMR) Subactivity is $185.46 million, an increase of $9.37 million, or 5.3 percent, over the FY 1994 Current Plan of $176.09 million.

(Millions of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Change Amount	Change Percent
Materials Research Project Support	80.54	88.40	95.27	6.87	7.8%
Materials Research Science & Engineering Centers	51.53	54.81	55.31	0.50	0.9%
National Facilities and Instrumentation 1/	32.44	32.88	34.88	2.00	6.1%
Total, DMR	$164.51	$176.09	$185.46	$9.37	5.3%

1/ Includes the National High Magnetic Field Laboratory funded in FY 1993 and 1994 in the former Major Research Equipment Subactivity in MPS.

The Materials Research Subactivity supports research to advance the fundamental understanding of the base science of materials, to promote the development of new materials with novel or superior properties, and to further the understanding of interrelationships among synthesis and processing, structure and composition, properties, and performance of materials at molecular, microscopic, and macroscopic levels. This research benefits from the Subactivity's involvement in the research and education initiatives in strategic areas, including **Advanced Materials and Processing, Advanced Manufacturing, High Performance Computing and Communications, Science, Mathematics, Engineering, and Technology Education, Environmental Research,** and **Biotechnology**. The Subactivity provides approximately 50 percent of the total Federal support for university-based research in materials. Approximately half of this support is for individual investigators and small groups. The remainder supports centers, major instrumentation, and large user facilities.

The FY 1995 Budget Request includes support for:

- $6.87 million increase for individual investigators and small groups through the Materials Research Project Support Program to a total of $95.27 million. The requested increase focuses on the research and education initiatives in strategic areas. Particularly important aspects of this research involve computational approaches to real materials and the enhancement of the materials science basis of manufacturing. In addition, the Subactivity will pursue innovative approaches to course, curriculum and training activities for future materials scientists and engineers.

- $500,000 increase for multi-investigator research primarily through the Materials Research Science and Engineering Centers Program. The increase will emphasize the establishment of university-industry-federal laboratory partnerships in the research initiatives in strategic areas.

- $2.00 million increase to a total of $34.88 million for the national user facilities including centers for synchrotron radiation, small-angle neutron scattering, high magnetic fields, and nano-fabrication technology. The budget also provides for the support of major instrumentation. The requested increase will be used to upgrade the facilities, to provide researchers with instrumentation at the national synchrotron facilities, and to develop novel characterization instruments.

- Within the National Facilities and Instrumentation program element, funding for the National High Magnetic Field Laboratory (NHMFL) at Florida State University will remain constant at $12.00 million, with funds shifting from capital investment to operations as the laboratory moves toward full operation in 1998. Over half the funds for construction of this laboratory have come from the state of Florida. In prior years, funding for the NHMFL was located in the former Major Research Equipment Subactivity in MPS. Beginning in FY 1995, the NHMFL will be funded in the Materials Research Subactivity.

Number of People Involved in DMR Activities

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Senior Researchers	1,530	1,540	1,540
Other Professionals	280	280	290
Post-Doctorates	480	500	570
Graduate Students	1,910	1,820	1,720
Undergraduate Students	380	400	420
Total Number of People	4,580	4,540	4,540

CHANGES IN BUDGET STRUCTURE

The name of the Materials Research Centers and Groups program element has been changed to Materials Research Science and Engineering Centers, reflecting the Materials Research Subactivity's commitment to emphasizing the importance of interdisciplinary, collaborative research for fundamental and strategic advances in the area of materials. This program element includes funds requested for five Science and Technology Centers administered by the Subactivity. There is no movement of funds between program elements.

SOCIAL, BEHAVIORAL AND ECONOMIC SCIENCES $112,610,000

The FY 1995 Budget Request for the Social, Behavioral and Economic Sciences (SBE) Activity is $112.61 million, an increase of $14.36 million, or 14.6 percent, over the FY 1994 Current Plan of $98.25 million.

(Millions of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Change Amount	Change Percent
Social, Behavioral and Economic Research	65.64	70.61	83.97	13.36	18.9%
International Cooperative Scientific Activities	13.25	15.71	16.71	1.00	6.4%
Science Resources Studies	11.78	11.93	11.93	0.00	0.0%
Total, SBE	$90.67	$98.25	$112.61	$14.36	14.6%

Modern life has been and continues to be profoundly transformed by such widely diffused research-based innovations as probability sampling methods, longitudinal survey techniques, and industrial quality-control methods. It has also been affected by an enhanced understanding of the bases of visual and auditory perception, the aging process, the roles of families and schools in the development of cognitive skills, the causes and consequences of violence and social inequality, the dynamics of inflation, and the conditions under which societal institutions can change over time. By understanding the world around us and how individuals cope, we can enhance individual productivity and improve the quality of life nationally.

The SBE Activity addresses a range of important national issues across the social, behavioral and economic sciences. Subject matters vary from global commerce and conflict to individual memory and motivation, and from changes in individual behavior to the environments in which change takes place. SBE enhances access to international opportunities in science and engineering in conjunction with other NSF research and education efforts. It also serves as the nation's principal source of data on science and engineering resources.

SBE programs are designed to perform three major functions:

- Develop basic scientific knowledge about human behavior, culture, interaction, and decision-making, and about social, political, and economic systems, organizations, and institutions;
- Advance the U.S. science and engineering enterprise by promoting healthy international relationships and enhancing the work of U.S. researchers through cooperative activities with foreign scientists, engineers, and their institutions; and
- Collect, analyze, and publish data on the status of the nation's science and engineering resources.

An example of the caliber of SBE research is:

- In 1993, two U.S. economists, Robert W. Fogel of the University of Chicago, and Douglass C. North of Washington University in St. Louis received the Nobel Prize in Economic Science for their contributions to economic history for work supported in part by NSF. They are credited with developing research methods based on rigorous economic theory and quantitative analysis of large-scale data bases. Their research reshaped and enriched our understanding of the economics of slavery in the ante-bellum South, the decline of hunger and the lengthening of life spans in Europe and America, and the contribution of railroads to the American economy.

Research in Strategic Areas

Examples of research in strategic areas include:

(Millions of Dollars)

	FY 1994 Estimate	FY 1995 Estimate	Percent Change
Advanced Manufacturing Technology	2.30	2.30	0.0%
Biotechnology	1.35	1.35	0.0%
Civil Infrastructure Systems	0.50	0.50	0.0%
Environmental Research	6.00	6.00	0.0%
High Performance Computing & Communications	1.25	3.13	150.4%
Science, Math, Engineering & Technology Education	2.60	2.60	0.0%
U.S. Global Change Research Program	11.00	24.00	118.2%

Note: Projects which have strong connections to the goals and objectives of more than one initiative are difficult to attribute to single initiative. In an effort to present a more precise measure of its research and education initiatives, NSF will redefine its internal data collection and analysis capabilities so that the allocation of resources for these initiatives can be shown in a mutually exclusive manner.

Research and education initiatives in strategic areas are the highest priority for the SBE Activity. The FY 1995 incremental spending for strategic areas ($14.88 million) slightly exceeds the FY 1995 funding increment for the directorate ($14.36 million), which will be offset by a small additional shift ($520,000) of base funds into strategic areas. The FY 1995 budget request includes the following highlights:

- Support for the **U.S. Global Change Research Program** totals $24.00 million in FY 1995, an increase of $13.00 million over FY 1994. This effort, focused in Human Dimensions of Global Change, supports research on human interactions in global change, including both direct human activity and indirect social, structural, and institutional issues that both affect and are affected by global change. The FY 1995 increase will support integrated assessments and policy science. Integrated assessments measure and model the interactions among human, biological, and physical systems that shape and follow global change. Policy science investigates the nature and consequences of options in natural resources management. The increase includes $1.00 million in the International Subactivity for critical access and collaborative opportunities for U.S. scientists and engineers in all fields with researchers from other countries.

- Research in **High Performance Computing and Communications** (HPCC)totals $3.13 million in FY 1995, an increase of $1.88 million over FY 1994. SBE activities in HPCC are related to support for observations, experiments and studies to determine how humans learn, access data, and use advanced computing capabilities. SBE currently supports research that models human cognition, as it unfolds through language, memory, problem-solving, decision-making, and learning. The FY 1995 increase will primarily support activities related to the **Information Infrastructure, Technology and Applications** (IITA) component. Companies have used results from prior research to improve human/machine interfaces. The on-going analyses hold promise for making advances in manufacturing and information systems and spurring gains in U.S. productivity and industrial competitiveness.

- Support for **Environmental Research** totals $6.00 million in FY 1995, the same level as in FY 1994. SBE will continue to support research on the impacts of human activity on the natural environment and the responses of economic, political, and social systems to environmental changes at local and regional levels. Examples of these efforts include: archeological investigations that clarify the environmental adaptation of human communities over time; studies on the interaction of migrations and population growth and systems of production; and interdisciplinary inquiries at unique sites from East Asia to sub-Saharan Africa.

- SBE support for the **Science, Math, Engineering and Technology Education** initiative totals $2.60 million in FY 1995, unchanged from FY 1994. Funding supports an array of activities aimed at improving math and science education and toward educating young social and behavioral scientists. As part of the initiative, SBE supports Research Experiences for Undergraduates, Research in Undergraduate Institutions, and Young Investigators.

- Research and education activities in the **Advanced Manufacturing Technology** initiative total $2.30 million. This request level supports ongoing research in the SBER Subactivity to build understanding of management, organizational change and decision-making related to technology transfer and technological innovation, especially for sustainable technologies. The Private Sector Partnership program in the Decision, Risk and Management Sciences program element is central to this research effort. The program makes competitive awards through joint NSF-industry funds to support research with the potential for improving technological or management practice.

- SBE activities in support of the **Biotechnology** initiative total $1.35 million. This supports research in the SBER Subactivity focused on ethical studies related to new biotechnology resources, as well as funding in the International Cooperative Scientific Affairs (INT) Subactivity to ensure access for all disciplines to biotechnology research opportunities and centers of excellence worldwide.

- In collaboration with other NSF activities, SBE seeks to create knowledge to support the intelligent and cost-effective renewal and management of **Civil Infrastructure Systems** in the U.S. The FY 1995 request of $500,000 is for work related to the social, economic, political, geographic, legal and management aspects of public infrastructure systems.

Modes of Support

SBE supports both ongoing and new activities in the following modes:

(Millions of Dollars)

	FY 1994 Estimate	FY 1995 Estimate	Percent Change
Research Projects	81.47	95.74	17.5%
Centers	0.90	0.99	10.0%
Education & Training	15.88	15.88	0.0%
Total, SBE	$98.25	$112.61	14.6%

Research Projects

The FY 1995 budget request for the Social, Behavioral and Economic Sciences Activity supports both ongoing and new research activities that will continue to make important contributions to individual and societal well-being. Budget highlights include:

- A $14.27 million increase in FY 1995, which will support additional research in the Human Dimensions of Global Change as part of the **U.S. Global Change Research Program** and additional research in HPCC/IITA.

- Ongoing support for the Human Capital Initiative in collaboration with other Federal agencies. The $1.00 million request is for multidisciplinary research on conditions that can enhance and constrain human potential and development. Emphasis will be placed on generating basic knowledge relevant to critical national problems, such as workforce productivity, aging, and violence.

- Continuing research related to intelligent systems totaling over $10.00 million in FY 1995.

Ongoing research areas include disciplinary and cross-disciplinary research programs in the social and behavioral sciences on issues such as the transformation of the former Soviet Union into democratic states with market-oriented economies; the management of scientific and technological risk and its importance for human well-being; and the effects of traditional agricultural practices on the maintenance of fragile ecosystems. Research that SBE has funded:

- Provided the first rigorous evidence from the former Soviet Union that private enterprises operate more efficiently than state-run operations. The evidence comes from analyses based on data at the level of individual firms.

- Deciphered patterns of sounds and inflections in speech. The findings have significant implications for automatic speech recognition that can enable computers to respond to natural human speech.

- Discovered that people who watch negative versions of campaign spots become more disenchanted with the political process and public officials and are less likely to vote than people who view the spots rarely, if at all. The results spring from a study noteworthy for its multiple strategies for obtaining and analyzing information on campaign advertising and voter turnout.

- Made it possible to predict how complicated structures will perform acoustically before they are built. The breakthrough comes through the collaboration between a U.S. engineer and his German counterpart.

- Yielded a mathematical model that can enhance the efficient storage of data on computer disks and determine the forest harvesting strategies that will best protect wildlife habitats. Mathematicians in the U.S. and Switzerland cooperated to derive the model.

Centers

SBE supports a Science and Technology Center for Cognitive Science at the University of Pennsylvania, in partnership with the Computer and Information Sciences and Engineering Activity. Support for the Center totals $990,000 in FY 1995, a $90,000 increase over FY 1994. The Center is engaged in interdisciplinary research and education on natural language acquisition and processing, perception and action, and logic and computation. The Center enjoys extensive interaction with over a dozen major industrial firms, which has already resulted in significant technology transfer in areas of commercial importance, such as robotics and automated natural language processing. The Center involves over 30 researchers and students.

Education and Training

SBE has an important role in education and training through programs to improve the skills of the cadre of professionals needed to meet national research needs. SBE supports students at the undergraduate level through Research Experiences for Undergraduates and Research in Undergraduate Institutions. SBE's undergraduate support totals $2.60 million in FY 1995. In addition, SBE participates in the NSF Young Investigator Awards, contributing $1.35 million in FY 1995 to support 27 young investigators. Another example of SBE's education activities is the Summer Institute in Japan, which is funded in the INT Subactivity. The program provides advanced U.S. graduate students with first-hand experience in Japanese research institutions, including not only government and university laboratories, but 23 corporate laboratories. In the past 3 years, 30 U.S. students have been hosted by Japanese corporations under this program.

The Science Resource Studies (SRS) Subactivity collects, analyzes, and disseminates data on the education and employment of scientific and technical personnel in the United States. This includes data on graduate students and postdoctorates, foreign participation in U.S. science and engineering, and the status of women and minorities. It also measures the public's science literacy and attitudes on science. SRS funding totals $11.93 million in FY 1995, remaining level over FY 1994. Ongoing activities include maintaining current surveys and performing a detailed analysis of data amassed in 1993 and 1994 on the scientific and engineering labor force of the U.S.

Number of People Involved in SBE Activities

The INT Subactivity indirectly supports approximately 1400 scientists and engineers for travel to seminars, symposia or workshops, and travel for cooperative research that adds an international dimension to awards made by other engineering and research programs in NSF. This may also include participation for U.S. scientists and engineers in international research opportunities under other U.S. and international auspices. These scientists are not included in the following table:

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Senior Researchers	1020	1040	1070
Other Professionals	160	170	170
Post-Doctorates	70	70	80
Graduate Students	850	900	920
Undergraduate Students	460	480	490
Total Number of People	2560	2660	2730

SBE Funding Profile

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Total Number of Awards	1,578	1,600	1,680
Statistics for Competitive Awards:			
Number	1,080	1,100	1,250
Funding Rate	34%	34%	37%
Median Annualized Award Size	$20,146	$24,500	$28,500
Average Annualized Award Size	$36,036	$38,500	$41,000
Average Duration (yrs.) \1	2.1	2.1	2.3

1\ Average Duration includes research projects only.

SOCIAL, BEHAVIORAL AND ECONOMIC RESEARCH $83,970,000

The FY 1995 Budget Request for the Social, Behavioral, and Economic Research (SBER) Subactivity is $83.97 million, an increase of $13.36 million, or 18.9 percent, over the FY 1994 Current Plan of 70.61 million.

(Millions of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Change Amount	Change Percent
Economic, Decision and Management Sciences	20.05	20.49	25.00	4.51	22.0%
Social and Political Sciences	15.80	16.52	20.00	3.48	21.1%
Anthropological and Geographic Sciences	12.92	12.70	14.80	2.10	16.5%
Cognitive, Psychological and Language Sciences	13.05	12.32	14.17	1.85	15.0%
Science, Technology and Society	3.82	8.58	10.00	1.42	16.6%
Total, SBER	65.64	70.61	83.97	13.36	18.9%

The SBER Subactivity supports research in a broad range of disciplines and in interdisciplinary fields. The goals of the division are to advance fundamental scientific knowledge in the following areas:

- cognitive and psychological capacities of human beings
- cultural, social, political, spatial, environmental, and biological factors related to human behavior
- human behavior, interaction, and decision-making
- social, political, legal, and economic systems, organizations, and institutions, and
- the intellectual, value, process, and impact contexts that govern the development and use of science and technology.

In addition to research in strategic areas, the SBER budget funds path-breaking work that has characterized the social and behavioral sciences at NSF. In certain disciplines -- anthropology, sociology, political science -- NSF is the principal source of awards for systematic data collection and analysis. The advances made in survey methodology, the modeling of political behavior, and analyses of complex systems originate in NSF awards to social and behavioral scientists.

The FY 1995 budget request includes:

- Research in the **U.S. Global Change Research Program** in the area of Human Dimensions of Global Change totals $23.00 million. Ongoing activities in the Economic, Decision and Management Sciences, Social and Political Sciences and the Anthropological and Geographic Sciences program elements include research on human interactions in global change, including both direct human activity and indirect social, structural, and institutional issues affecting global change. Special emphasis is given to research that draws on and show promise of contributing to general understandings of the ways that human activities impact on natural systems; of the ways that humans respond to changing environmental conditions; and of the complex ways that human systems interact with natural systems in a dynamic framework. In support of these activities, a competitive process is planned for the establishment of a center or centers for the Human Dimensions of Climate Change. The FY 1995 increment of $12.00 million is distributed across the program elements and will be used primarily to perform integrated assessments and policy science.

- **High Performance Computing and Communications** research, primarily in the Social and Political Sciences and the Cognitive, Psychological and Language Sciences program elements, totals $3.13 million in FY 1995, an increase of $1.88 million over FY 1994. Ongoing activities include research that models human cognition as it unfolds through language, memory, problem-solving, decision-making and learning. SBER also funds observations and experiments to determine how humans learn, access data, and use advanced computing capabilities. The FY 1995 increase will primarily support activities related to the **Information Infrastructure Technology and Applications** component.

- **Biotechnology** efforts total $1.35 million in FY 1995. The program on Ethics and Values Studies, in the Science, Technology and Society program element, leads the SBER efforts in research that explores the ethical, value, or policy aspects of issues facing members of all scientific and engineering research and educational communities. Through its support of projects that examine ethical, value, or policy aspects of interactions among individuals and institutions involved in science and technology, the program seeks to contribute toward more general knowledge about the basic processes that underlie those interactions and to enhance understanding of the ethical and social values, policies, and mutual obligations and responsibilities that arise through those interactions.

SBER plans to:

- Spend $10.00 million on intelligent systems to support systematic multidisciplinary research that leads to techniques for database analyses, computational tools serving a wide range of new needs, methods for creating and managing large scale information systems, and systems to enhance understanding of how humans learn, remember, communicate, and make decisions, as well as to develop computer analogs of these processes.

- Make awards totaling $1.00 million for multidisciplinary research associated with the Human Capital Initiative. This will include funds for research on conditions that can enhance and constrain human potential and development. Emphasis will be placed on generating basic knowledge relevant to critical national problems, such as workforce productivity, aging, and violence.

Number of People Involved in SBER Activities

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Senior Researchers	1000	1020	1040
Other Professionals	160	170	170
Post-Doctorates	60	70	80
Graduate Students	840	890	910
Undergraduate Students	450	470	480
Total Number of People	2510	2620	2680

INTERNATIONAL COOPERATIVE SCIENTIFIC ACTIVITIES $16,710,000

The FY 1995 Budget Request for the International Cooperative Scientific Activities (INT) Subactivity is $16.71 million, an increase of $1.00 million, or 6.4 percent, over the FY 1994 Current Plan of $15.71 million.

(Millions of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Change Amount	Change Percent
International Cooperative Scientific Activities	13.25	15.71	16.71	1.00	6.4%
Total, INT	13.25	15.71	16.71	1.00	6.4%

The INT Subactivity supports research activities that promote partnerships between U.S. and foreign researchers, enhance access to critical research conducted outside the United States, and increase knowledge of mutually beneficial research opportunities abroad. INT programs stimulate research cooperation with scientists and engineers in virtually all of the developed and developing countries of the world and in all fields of science and engineering supported by the Foundation.

Ongoing activities within the budget request of $16.71 million include support to:

- continue exploratory phases of international research collaborations, workshops, and studies that aim to establish significant, long-term cooperative research relationships;
- enhance the international perspectives of the next generation of U.S. scientists and engineers through research participation, fellowships, and summer programs;
- continue cooperative programs with Eastern Europe and the Newly Independent States, which promote new partnerships between centers of excellence and scientific organizations in the U.S. and in these regions;
- stimulate cooperation between U.S. and foreign scientists and engineers in geographical regions where research activities are difficult to undertake or have been neglected; and
- fund U.S. participation in the International Institute for Applied Systems Analysis (IIASA) in Vienna, Austria at the level of $2.30 million.

The $1.00 million increment in FY 1995 will support the **U.S. Global Change Research Program** to ensure access for U.S. scientists and engineers to unique research sites and center of excellence, as well as to multilateral research programs addressing topics in global change. This involvement illustrates the continuing interest of this Subactivity in identifying opportunities for enlarging global perspectives.

Number of People Involved in INT Activities

The INT Subactivity indirectly supports approximately 1400 scientists and engineers for travel to seminars, symposia or workshops, and travel for cooperative research that adds an international dimension to awards made by other engineering and research programs in NSF. This may also include participation for U.S. scientists and engineers in international research opportunities under other U.S. and international auspices. Approximately 50 researchers and students are directly supported through salary or stipends. INT rarely provides direct support of this type.

SCIENCE RESOURCES STUDIES $11,930,000

The FY 1995 Budget Request for the Sciences Resources Studies (SRS) Subactivity is $11.93 million, unchanged from the FY 1994 Current Plan level.

(Millions of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Change Amount	Change Percent
Science Resources Studies	11.78	11.93	11.93	0.00	0.0%
Total, SRS	11.78	11.93	11.93	0.00	0.0%

The Science Resource Studies Subactivity collects, analyzes and disseminates data on domestic and international resources devoted to science and technology. This information is crucial to NSF and other Federal policy-makers concerned with the health of the nation's science and technological enterprise. The program is the primary source of statistics on scientific and technical personnel (including statistics on employment, women and minorities, and projections of supply and demand); information on graduate and undergraduate education in science and engineering; identifying trends in research and development, and tracking indicators of national and international science and engineering impacts.

Significant recent accomplishments include:

- The Congressionally mandated report Science and Engineering Indicators that will be transmitted to Congress early in 1994. This latest issue of the biennial report will include indicators on:
  - impact of defense downsizing on R&D and employment;
  - technology transfer;
  - trade in high tech products and global competitiveness;
  - international and domestic S&T cooperation and partnerships;
  - education and employment patterns for women and minorities in S&E; and
  - emigration of scientists and engineers from Russia.

- A new report, Human Resources for Science and Technology: The Asia Region, provides detailed information on the state of science and technology in the Asian region, in six countries (China, India, Japan, Singapore, South Korea and Taiwan) where production of science and engineering degrees has grown dramatically in the last 15 years. Other recently released special reports include Foreign Participation in U.S. Academic Science and Engineering, and Undergraduate Origins of Recent Science and Engineering Doctorate Recipients.

Periodic data collection costs make up a substantial part of the budget for the Science Resources Subactivity. During FY 1995 data collection costs for the National Survey of College Graduates will continue to decline by an estimated $600,000 as the program focuses on data analysis. This, together with funds from other internal reallocations, makes funding available for the following program enhancements:

- To improve data collection and analysis of national needs for academic research facilities and instrumentation ($75,000) and to develop new science and engineering indicators, particularly more extensive international data ($200,000).

- For new data collection and data analysis related to the planned survey of industrial innovation ($200,000) and to improve the analytical program related to modeling the science and engineering labor force ($125,000).

Number of People Involved in SRS Activities

SRS programs do not generally provide direct support for researchers or students.

U.S. POLAR PROGRAMS $225,430,000

The FY 1995 Budget Request for U.S. Polar Programs is $225.43 million, an increase of $4.73 million, or 2.1 percent, over the FY 1994 Current Plan of $220.70 million.

(Millions of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Change Amount	Change Percent
U.S. Polar Research Programs	180.78	158.10	162.83	4.73	3.0%
U.S. Antarctic Logistical Support Activities	63.43	62.60	62.60	0.00	0.0%
Total, Polar Programs	244.21	220.70	$225.43	$4.73	2.1%

NSF conducts Polar Programs through two Activities:

- U.S. Polar Research Programs consolidate funding for both arctic and antarctic research as well as Operations and Science Support.

- U.S. Antarctic Logistical Support Activities funds logistics provided by the Department of Defense that contribute to the U.S. presence in Antarctica.

For Polar Programs in FY 1995, the entire requested increase of $4.73 million is for research projects aimed at illuminating global climate change issues; related disciplinary efforts; and astrophysical research at the South Pole.

The Arctic and Antarctic are important because of their major influence on world weather and climate, and because they are regarded as the likely bellwether of global climate change. In addition, the polar regions provide special opportunities for international cooperation. The Foundation is charged with supporting National policy goals in Antarctica: to maintain the Antarctic Treaty, ensure that the continent continues to be used only for peaceful purposes, foster cooperative research contributing to the solution of regional and world-wide problems, and protect the environment. Scientific research is the means through which these goals are pursued. In the Arctic, NSF provides interagency leadership for research planning as directed by the Arctic Research Policy Act of 1984. NSF also supports university research to increase our knowledge of the region to allow better prediction of arctic phenomena and improved resource stewardship and use in the United States' arctic State, Alaska.

Highlights of recent research include:

- GISP 2 -- The second Greenland Ice Sheet Project resulted in the deepest ice core ever drilled. Bedrock was reached in July, 1993. The core provides the basis for new insights into past climate change. Of particular importance are records of unexpectedly rapid and major climate change evident throughout the core, and chemical records suggesting mechanisms for the climate changes that have taken place.

- Antarctic ozone hole -- This climate change phenomenon reached its greatest extent and lowest level ever, according to balloon-based observations under the Antarctic Research Program and satellite measurements. Some investigators think that this results from the explosion of the Philippine volcano, Mt. Pinatubo, in 1991. But chloroflurocarbons are a major factor as well. In spite of decreases in their production as a result of the Montreal Protocol, their continued accumulation in the stratosphere is expected to contribute to increases in the antarctic ozone hole until early in the next century.

- Antarctic astrophysics –Through the Center for Astrophysical Research in Antarctica (CARA), the most precise measurement of cosmic background radiation ever made took place at the South Pole during 1993. Combined with satellite measurements, this research provides basic constraints on theories of the origin of the universe, a central issue of cosmology. Also at the South Pole, the installation of a neutrino detector that uses the ice sheet itself as part of the detector is underway with completion planned for FY 1995. The potential is to start a new field, neutrino astronomy, and in so doing to open a new window on the universe.

The following table shows Polar Program components:

(Millions of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request
U.S. Polar Research Programs			
U.S. Arctic Research Program	22.10	25.20	27.38
U.S. Antarctic Research Program	26.73	28.48	31.03
Operations and Science Support	72.85	104.42	104.42
U.S. Antarctic Logistical Support	59.10		
Subtotal, U.S. Polar Research Programs	**$180.78**	**$158.10**	**$162.83**
U.S. Antarctic Logistical Support Activities			
U.S. Antarctic Logistical Support		56.60	62.60
Safety, Environment and Health	14.07	6.00	0.00
Aircraft Procurement	49.36	0.00	0.00
Subtotal, U.S. Antarctic Logistical Support	**$63.43**	**$62.60**	**$62.60**
Total, Polar Programs	**$244.21**	**$220.70**	**$225.43**

Funding of polar efforts has been restructured in the FY 1993-FY 1995 time period. Changes are:

- The Arctic Research Program is now included within U.S. Polar Research Programs.
- The Safety, Environment and Health (SEH) initiative completes its planned five-year effort in FY 1994. Continued environmental activities will be supported through Operations and Science Support in FY 1995.
- Logistics support by DOD is included within U.S. Antarctic Logistical Support beginning in FY 1994. In FY 1995 further consolidation takes place.
- All polar activities – U.S. Polar Research Programs and U.S. Antarctic Logistical Support Activities – are included within the Foundation's Research and Related Activities appropriation beginning in FY 1995.

Modes of Support

Polar Programs supports its activities through the following modes:

(Millions of Dollars)

	FY 1994 Estimate	FY 1995 Estimate	Percent Change
Research Projects	49.15	53.55	9.0%
Centers	3.23	3.56	10.2%
Facilities	167.02	167.02	0.0%
Education & Training	1.30	1.30	0.0%
Total, Polar Programs	$220.70	$225.43	2.1%

Research Projects

Funding for research projects totals $53.55 million in FY 1995, an increase of $4.40 million over FY 1994. Priority is given to research on strategic issues that can be uniquely addressed in the polar regions. Research projects supported by polar programs are primarily those in the geoscience and life science disciplines. They also include interdisciplinary programs such as Arctic Systems Science (ARCSS), arctic social sciences, and astronomy and astrophysics at the South Pole.

The polar regions represent natural laboratories for investigating the upper atmosphere, high latitude and cold climate phenomena, and the weather. Studies focus on the solid earth, the overlying glacial and surrounding sea ice, the oceans, the atmosphere, and the terrestrial and marine biota. The dry atmosphere and continuous viewing allowed by the U.S. station at the South Pole provide unique opportunities for astrophysical observations. Ocean studies address the dynamics, paleontology, and ecology of the seas surrounding the Antarctic continent especially as influenced by: low temperatures, long periods of daylight and darkness, sea ice dynamics and high nutrient contents. Earth sciences address geology, geophysics, glaciology, and plate tectonics. These research efforts seek to place environmental processes in a global context.

Polar research programs also fund curatorial centers for storing and distributing ice- and ocean-sediment cores, and for sorting and distributing natural history specimens; publications that disseminate polar research information; and development of scientific advice through support of the Polar Research Board of the National Research Council.

Centers

Polar Programs includes a single center, the Center for Astrophysical Research in Antarctica (CARA), which conducts research in both astronomy and astrophysics at the South Pole. In FY 1995 CARA will have a budget of $3.56 million, an increase of $330,000 over FY 1994.

CARA provides the critical mass of astronomers and astrophysicists for the development of the South Pole Station as an observatory. It includes 16 researchers and 48 graduate students. Educational outreach involves hundreds of inner-city Chicago school children in astronomy activities. AT&T and Rockwell International are major corporate participants.

Facilities

The $167.02 million for facilities and their operation make possible U.S. antarctic research by providing the necessary infrastructure for scientists and their instruments. Of this amount, $62.60 million is logistical support provided by DOD. The balance, $104.42 million, is for operations, facilities and science support.

Major facilities follow:

- Stations – three are maintained by the U.S.
  - McMurdo Station, the main science and logistics base, on Ross Island 2,200 miles south of Christchurch, New Zealand (summer population, 1,200).
  - South Pole Station, located 2 miles high on top of the polar ice cap is an unparalleled platform for atmospheric and astronomic research (summer population, 125).
  - Palmer Station, primarily for biological and ecosystem research, on an island adjacent to the Antarctic Peninsula (summer population, 42).
- Aircraft
  - Seven ski-equipped C-130 aircraft are operated for the program by the Navy to provide inter- and intra- continental transportation and field support. An additional LC-130 was funded in FY 1993.
  - Six Navy UH-1N helicopters provide field support and search and rescue.
  - Two leased ski-equipped Twin Otter aircraft provide field support.
- Research Vessels
  - NSF via its support contractor leases two research vessels, the R/V NATHANIEL B. PALMER, a year-old, specially-constructed research icebreaker, and the R/V POLAR DUKE, which is also used to supply Palmer Station.
  - The 10-year lease for POLAR DUKE will expire at the end of 1994. A competition for a successor for POLAR DUKE will be conducted in the spring of 1994. Because of the additional research capacity provided by R/V PALMER, a ship with capability equivalent to POLAR DUKE will meet program requirements; thus, no increase in funding is planned.
- Icebreaker
  - Each January a Coast Guard icebreaker breaks the channel to McMurdo Station for a tanker and supply ship, and provides some science support.
- Operations Support
  - The civilian contractor, Antarctic Support Associates, operates the stations, leases private ships and planes, constructs facilities, and provides science support (400-600 people, depending on the season).

Education and Training

Education and training efforts are supported at a level of $1.30 million in FY 1995, the same as FY 1994. Activities are directed primarily to research experience for college undergraduates and faculty. In addition, because of the special interest of polar regions to precollege students, special activities are addressed to them including opportunities for field work in Antarctica mentored by experienced scientists.

Number of People Involved in Polar Programs Activities

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Senior Researchers	700	730	770
Other Professionals	270	280	290
Post-Doctorates	130	140	150
Graduate Students	280	290	310
Undergraduate Students	110	120	120
Total Number of People	1,490	1,560	1,640

Polar Programs Funding Profile

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Total Number of Awards	416	437	459
Statistics for Competitive Awards:			
Number	168	180	195
Funding Rate	59%	47%	46%
Median Annualized Award Size	$70,984	$78,000	$86,000
Average Annualized Award Size	$135,693	$135,000	$135,000
Average Duration (yrs.) \1	2.4	2.5	2.5

1\ Average Duration includes research projects only.

CHANGES IN BUDGET STRUCTURE

As part of an Administration effort to reduce the administrative burden associated with maintaining a large number of separate appropriations, the U.S. Polar Research Programs and the U.S. Antarctic Logistical Support appropriations are merged with the Research and Related Activities appropriation in FY 1995. This results in a smaller number of appropriation accounts and a consolidation of research activities together with their support.

U.S. POLAR RESEARCH PROGRAMS $162,830,000

The FY 1995 Budget Request for U.S. Polar Research Programs is $162.83 million, an increase of $4.73 million, or 3.0 percent, over the FY 1994 Current Plan of $158 10 million.

(Millions of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Change Amount	Change Percent
U.S. Arctic Research Program	22.10	25.20	27.38	2.18	8.7%
U.S. Antarctic Research Program	26.73	28.48	31.03	2.55	9.0%
Operations and Science Support	72.85	104.42	104 42	0.00	0.0%
U.S. Antarctic Logistical Support /1	59.10	-	-		
Total, U.S. Polar Research Program	$180.78	$158.10	$162.83	$4.73	3.0%

1/ Moved to U.S. Antarctic Logistical Support Activities in FY 1994

Research in the Arctic and the Antarctic reflects scientific interest stretching from the ocean bottom through the ice cover and into space where the interaction of solar radiation with the Earth's atmosphere begins. In addition, South Pole astronomy and astrophysics are increasing in importance as a result of successful new activities there.

Research in Strategic Areas

Examples of research in strategic areas include:

(Millions of Dollars)

	FY 1994 Estimate	FY 1995 Estimate	Percent Change
Biotechnology	2.43	2.43	0.0%
Environmental Research	5.82	6.32	8.6%
High Performance Computing & Communications	0.18	0.18	0.0%
Science, Math, Engineering and Technology Education	1.18	1.18	0.0%
U.S. Global Change Research Program	20.00	22.20	11.0%

Note: Projects which have strong connections to the goals and objectives of more than one initiative are difficult to attribute to single initiative. In an effort to present a more precise measure of its research and education initiatives, NSF will redefine its internal data collection and analysis capabilities so that the allocation of resources for these initiatives can be shown in a mutually exclusive manner.

The FY 1995 budget request of $22.20 million for the **U.S. Global Change Research Program** includes:

- Research in Arctic Systems Science that supports regional investigations to provide input for the modeling of global climate change and to assess the impact of change on arctic living resources.
- In the Antarctic, research on the ozone hole and biological effects of associated increased ultraviolet radiation, ocean ecosystem research, and participation in the antarctic aspects of world-wide global change ocean programs such as Joint Global Ocean Flux Studies which addresses the capacity of the Antarctic Ocean to absorb "excess" greenhouse gases such as CO2.

In the other special emphasis areas:

- Antarctic participation in the communications portion of the **High Performance Computing and Communications** initiative is directed at telemetering large data streams from Antarctica to the U.S. .
- Efforts in the **Science, Mathematics, Engineering and Technology Education** initiative are directed at college students and faculty.
- **Biotechnology** efforts focus on the application of molecular techniques to address major environmental research questions such as adaptation of organisms to extreme climatic conditions and bioremediation of polar environments.
- **Environmental Research** includes investigations of physical, chemical and biological processes within local environments in both polar regions and research specifically aimed at improved environmental protection.

Research in these areas of special emphasis is supported through both the U.S. Arctic Research Program and the U.S. Antarctic Research Program.

U.S. Arctic Research Program

The U.S. Arctic Research Program includes two components :

(Millions of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request
Arctic Research Projects	21.57	24.64	26.81
Arctic Research Commission	0.53	0.56	0.57
Total, Arctic Research Program	$22.10	$25.20	$27.38

About 75 percent of NSF support for university-based arctic research is provided by Arctic Research Projects. Projects involve the arctic ocean, atmosphere, land areas and their people, plants and wildlife. In addition to individual projects supported in the various disciplines, the Arctic Systems Science (ARCSS) program focuses on understanding the arctic component of global climate change. In addition to supporting arctic research, the Arctic Research Program funds the Arctic Research Commission, an independent Federal agency funded through NSF.

The FY 1995 Budget Request includes:

- Arctic Systems Science (ARCSS), part of the U.S. Global Change Research Program, totals $14.10 million in FY 1995, an increase of $1.20 million. Ongoing activities include paleoclimate research based on Greenland ice cores and on sediments from arctic lakes. Land-ocean-ice-atmosphere interactions are also investigated to provide input for improved climate modeling. ARCSS is the principal source of Arctic information and data to the international global change and global environmental health programs such as IGBP (International Geosphere Biosphere Program), GEWEX (Global Energy and Water Cycle Experiment), and MAB (Man and the Biosphere Program). The increase in FY 1995 will support expanded ARCSS land and ocean investigations, and initiate a new project, SHEBA (Surface Heat Budget for the Arctic Ocean), to provide critical cloud and ocean surface radiation information needed for global climate modeling.

- Other arctic research projects are in arctic biological, atmospheric, ocean, earth and social sciences. Much of this research relates to global change or local environmental issues. The budget, totaling $11.74 million in FY 1994, increases by $970,000 to $12.71 million in FY 1995 across these areas.

U.S. Antarctic Research Program

The U.S. Antarctic Research Program (USARP) budget for FY 1995 totals $31.03 million, an increase of $2.55 million. The program supports over 110 research projects in Antarctica each year. This research, best or uniquely carried out in Antarctica, provides a key element of U.S. presence there. Investigations focus on the earth, the ice, surrounding oceans, the atmosphere and terrestrial and marine biota. The cold, dry atmosphere at the South Pole Station is ideal for several kinds of astronomical and astrophysical investigations. Because conduct of research in Antarctica is expensive, significant attention is devoted to the preparation for projects deployed there. Data analysis and modeling is supported as well.

The FY 1995 budget increase of $2.55 million will provide for:

- global change research aboard the icebreaking research vessel, R/V NATHANIEL B PALMER, and computer simulation modeling of Antarctic data sets;
- environmental research activities conducted at the newly completed McMurdo science laboratory, and
- research in astronomy and space physics that capitalizes on the unique location of the South Pole Station.

Operations and Science Support

Antarctic Operations and Science Support makes research in Antarctica possible by providing the required facilities, environmental protection and much of the other support.

The breakout of science support, operations and environmental protection funding follows:

	FY 1994 Estimate	FY 1995 Estimate
Science Support	59.6	53.6
Operations and Facilities	40.8	42.3
Environmental Protection	4.0	8.5
Total, Antarctic Operations & Science Support	$104.4	$104.4

While there is no change from FY 1994 in the total budget request for FY 1995, there are shifts within the total.

- The apparent decrease in science support reflects the consolidation of part of the Navy Science Support under U.S. Antarctic Logistical Support Activities.
- The increase in operations and facilities reflects the transfer of safety and health efforts from U.S. Antarctic Logistical Support Activities.
- The increase in environmental protection reflects the shift of continuing environmental efforts from U.S. Logistical Support Activities to Operations and Science Support, where similar activities are currently conducted. Environmental protection activities are aimed at minimizing impact of program

activities on the antarctic environment. Major efforts have been and will continue to be devoted to mitigating adverse effects of past activities. All solid and hazardous waste is shipped from Antarctica. A new research program aimed at minimizing environmental damage in cold regions was initiated in FY 1994.

Antarctic science support and operations are provided primarily by a contractor, Antarctic Support Associates (ASA); a relatively small component of civilian support for science is provided by the Navy. A Coast Guard Icebreaker provides access to McMurdo Station for resupply ships. Other agencies also provide technical support in areas of expertise such as construction and communications.

Costs by major program category follow:

(Millions of Dollars)

	FY 1994 Estimate	FY 1995 Estimate
Antarctic Support Associates (ASA)		
Headquarters - project administration	2.4	2.5
Logistics - Transportation of cargo and people, materials and inventory	9.7	10.0
Continental System - Operations at McMurdo and South Pole	12.9	13.3
Peninsul and Ships - ships & Palmer Station operations	21.0	22.5
Engineering - construction and maintenance	9.4	7.0
Science Support - science facility & field camp operations	9.9	10.2
Information Systems - data handling & communications	6.5	6.7
Safety, Environment, Health - shifted from U.S. Antarctic Logistical Support Activities	--	6.0
Overhead and Fee	5.7	6.3
Subtotal, ASA	$77.5	$84.5
Other		
Navy Support of Science - LC-130 and helicopter support	17.0	11.0
Coast Guard Support - icebreaking to McMurdo Station	2.4	2.5
Other Federal Agencies - technical and science support	1.5	1.7
Other Contractual Support	6.0	4.7
Subtotal, Other	$26.9	$19.9
Total, Operations and Science Support	**$104.4**	**$104.4**

Anticipated cost increases are offset by a decrease in construction costs as projects are completed under the Engineering category of the ASA budget -- such as the move of Williams Field skiway. This move was made necessary by an iceshelf flow of several hundred feet per year, and the breaking of its seaward edge. The requirement for replacement provided an opportunity to restructure facilities to increase efficiency.

U.S. ANTARCTIC LOGISTICAL SUPPORT ACTIVITIES $62,600,000

The FY 1995 budget request for Antarctic Logistical Support Activities is $62.60 million, the same as FY 1994

(Millions of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Change Amount	Change Percent
U.S. Antarctic Logistical Support	0.00*	56.60	62.60	6.00	11%
Safety, Environment and Health	14.07	6.00	0.00	(6.00)	-100%
Aircraft Procurement	49.36	0.00	0.00	0.00	n/a
Total, U.S. Antarctic Logistical Support	63.43	62.60	62.60	0.00	0%

* Funded in Operations and Science Support in FY 1993

U.S. Antarctic Logistical Support is managed by the Naval Support Force Antarctica and provided primarily by the Navy and other DOD components. The major elements of the budget are:

- Personnel, the largest cost element, includes about 700 military personnel of the Naval Support Force Antarctica (NSFA) and Antarctic Development Squadron Six (VXE-6). Air logistics includes the cost of VXE-6 flight activity and aircraft maintenance and upgrade. Also included are the costs of additional chartered airlift by the U.S. Air Force and the 109th Tactical Airlift Group of the New York Air National Guard, and of personnel transportation in connection with the Antarctic Program. The Navy expenses not budgeted here are part of the LC-130 and helicopter direct support of science projects; these are funded as part of the Operations and Science Support in the Polar Research Activity.

- Surface Transportation costs include the charter of a Military Sealift Command cargo ship for the resupply of McMurdo Station, as well as surface freight charges.

- Maintaining and operating the air logistics infrastructure on the Antarctic Continent, particularly airfields near McMurdo Station, providing fuel for station operations, etc.

- Support of the logistics facilities of the Naval Support Unit in Christchurch, New Zealand, and of NSFA and VXE-6 in California.

- Procurement costs, primarily associated with aircraft navigation system improvements plus other procurements by NSFA, to allow the provision of logistics.

The following table shows details for FY 1994 and FY 1995.

(Million of Dollars)

	FY 1994 Estimate	FY 1995 Estimate
Personnel -- NSFA and VXE-6	23.5	27.2
Travel -- by Navy personnel	4.0	4.3
Flight Operations -- aircraft operations & maintenance, chartered airlift	13.4	15.4
Surface Transportation -- ship & associated costs	5.1	5.1
Antarctic Continental Operations -- ground fuel & aircraft operations	7.3	7.3
U.S. / N.Z. Operations -- facilities operations & maintenance	1.9	1.9
Contracts and Procurements	1.4	1.4
Total	$56.6	$62.6

The increases in personnel and flight operations reflect consolidation of logistics previously funded through Operations and Science Support.

The Safety, Environment and Health initiative is completed in FY 1994. However, activities started under that initiative, such as removal of all solid waste from Antarctica rather than burning it or leaving it in dumps are continuing. These efforts will be consolidated in FY 1995 under the operations portion of the U.S. Polar Research Programs Activity.

Acquisition of the LC-130 aircraft funded in FY 1993 is underway through the Department of Defense. Delivery is expected at about the end of calendar year 1995. A revised long-range plan for LC-130 acquisition is being formulated as part of a report on future DOD support of the U.S. Antarctic Program that is due to the Appropriations Committees on May 1, 1994.

CRITICAL TECHNOLOGIES INSTITUTE $2,000,000

The FY 1995 Budget Request for the Critical Technologies Institute (CTI) is $2.00 million, an increase of $0.50 million, or 33.3 percent, over the FY 1994 Current Plan of $1.50 million.

(Millions of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Change Amount	Change Percent
Critical Technologies Institute	$1.00	$1.50	$2.00	$0.50	33.3%

The Critical Technologies Institute is a Federally-Funded Research and Development Center that provides analytical support to the Office of Science and Technology Policy. Policy guidance for the Institute is provided by an interagency Operating Committee which functions as the governing board of the Institute, The Institute provides assistance to OSTP to identify near-term and long-term objectives for research and development; analyze the production capability and economic viability with respect to such technologies; and provide options for achieving those objectives.

The National Science Foundation's sponsorship will continue to consist of financial, management, and audit oversight. The Institute itself is operated as a separate entity by the present contractor, RAND corporation.

Policy guidance for the Institute is provided by an Operating Committee. The Operating Committee, comprised of the Secretaries, or their designees, of Defense, Health and Human Services, Energy, and Commerce, the Administrator of NASA, the Director of the National Science Foundation, and four other members named by the President, will set the Institute policy, priorities, and goals, and will submit an annual report to the President.

The FY 1995 budget request includes:

- Analytic activities in support of OSTP ($ 0.9 million). Tasks are underway on behalf of each of the four OSTP associate directors for Technology, Science, Environment, and National Security and International Affairs. Some of the work is for specific directorates, such as uses of technology in education and training, or support of the electronics working group; other work is of interest across the OSTP structure, as for instance, work on space policy and environmental technology. In each instance, CTI and OSTP have worked to specify analysis that will assist OSTP in considering options for future decisions.

- Requests regarding performance goals for Federal investment in science and technology, support of the National Critical Technologies Panel, and industry studies such as the one recently completed on the U.S. machine tool industry ($ 0.3 million). CTI also provides assistance to OSTP with specific requests placed by the Congress.

- The development of a comprehensive and detailed database of Federal research and development effort that is being used in the early work of the committees of the National Science and Technology Council. ($ 0.8 million). CTI is also developing capabilities that will be valuable for broad application by OSTP and other parts of the government.

EDUCATION AND HUMAN RESOURCES $586,000,000

The FY 1995 Budget Request for Education and Human Resources (EHR) is $586.00 million, an increase of $16.40 million, or 2.9 percent, over the FY 1994 Current Plan of $569.60 million.

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Change Amount	Change Percent
Systemic Reform	82.29	109.98	117.98	8.00	7.3%
Elementary, Secondary and Informal Education	184.68	198.28	199.28	1.00	0.5%
Undergraduate Education	61.91	81.01	83.01	2.00	2.5%
Graduate Education and Research Development	85.41	66.46	71.06	4.60	6.9%
Human Resource Development	49.61	66.39	66.39	0.00	0.0%
Research, Evaluation and Dissemination	41.16	47.48	48.28	0.80	1.7%
Total, EHR	$505.06	$569.60	$586.00	$16.40	2.9%

Education and Human Resources (EHR) responsibility is to define and fund programs and projects that support the educational aspects of the Foundation's mission. The programs supported by EHR represent a cohesive and comprehensive set of activities, augmented by informal science experiences, which encompass every level of education and every region of the country. Providing direct support to students and teachers, these programs offer a level of commitment, visibility, and continuity that is responsive to the national concern with science, mathematics, engineering and technical education. EHR also plays a major role in developing human resources for science and engineering.

In FY 1991, EHR initiated the only major federal agency program encompassing comprehensive, systemic approaches to improve science and mathematics education, particularly at the K -12 level. The Statewide Systemic Initiatives (SSI), followed by the Urban Systemic Initiatives (USI) in FY 1993 and the Rural Systemic Initiatives (RSI) in FY 1994, illustrate this approach. The focus is on whole systems aimed at making improvements in science, mathematics and technology education at the state level, major urban centers, and rural areas through the involvement of broad partnerships in the development of goals, solutions and actions. The goal of total system reform is based on the underlying philosophy that all students can learn and achieve in science and mathematics at much higher levels than at present.

EHR participates in several interagency initiatives:

- **Science, Mathematics, Engineering and Technology Education (SMETE)** initiative will total $531.66 million in FY 1995. This initiative addresses many of the challenges posed by the National Education Goals established by the President and the nation's governors in 1990.
  - **Advanced Technology Education (ATE)**, a new program, established in FY 1994 to meet the increasing demands for a highly-skilled, competitive workforce, will continue to be a major focus in the SMETE initiative in FY 1995.
- **High Performance Computing and Communications (HPCC)** initiative, including the **Information Infrastructure Technology and Applications (IITA)** component, will total $17.87 million in FY 1995. In the Applications of Advanced Technology (AAT) program, EHR supports the expansion of the Networking Infrastructure for Education (NIE) test beds, demonstration projects, and research and development related to interagency collaborations.
- Participation in the **Biotechnology** initiative in FY 1995 will total $11.80 million, and in the **Advanced Materials and Processing Program** initiative the total will be $7.10 million.

Participation in these activities will help create a sustainable infrastructure for education reform and expand other NSF initiatives. The following table details the Science, Mathematics, Engineering and Technology Education (SMETE) initiative support by level of education.

SUPPORT BY EDUCATION LEVEL

(Millions of Dollars)

	FY 1994 Estimate	FY 1995 Estimate	Change Amount	Change Percent
K-12	351.18	360.05	8.87	2.5%
Undergraduate	99.81	102.25	2.44	2.4%
Graduate	58.79	63.39	4.60	7.8%
Public Understanding of Science	6.03	5.97	(0.06)	(1.0%)
SMETE Total	515.81	531.66	15.85	3.1%
Other*	53.79	54.34	0.55	1.0%
TOTAL, EHR	$569.60	$586.00	16.40	2.9%

* includes EPSCoR, Faculty Awards for Women, Visiting Professorship for Women, and Minority Research Centers for Excellence

EHR plays a major role in science, mathematics engineering and technology education, funding about thirty percent of the total federal effort in FY 1995. The FY 1995 budget request by level of education includes:

K-12 Support

Support at the K-12 level totals $360.05 million, an increase of $8.87 million over the FY 1994 estimate. This support is focused primarily in the Systemic Reform and Elementary, Secondary and Informal Science Activities of EHR.

- **Systemic Reform** activities increases $8.00 million, or 10.2 percent to total $86.06 million. The Urban Systemic Initiatives (USI) will increase $6.00 million, enabling six to ten of the awardee cities to continue to the planned second-year level. The Rural Systemic Initiatives (RSI) will increase $2.0 million, providing one to two implementation awards. The Statewide Systemic Initiatives (SSI) is sustained at the FY 1994 level with 26 ongoing awards. The *Improving America's Schools Act of 1993* will target school attendance in areas with a high percentage of low income school children. Some of these areas are being addressed by NSF's rural and urban initiatives.

- **Advanced Technological Education (ATE)** a new program in FY 1994, will increase $1.00 million for a total of $5.83 million. ATE, jointly operated in the Elementary, Secondary and Informal Science and the Undergraduate Education Activities, promotes improvement in secondary curricula and instruction to help in the transition of students to the high-performance workforce. The FY 1995 increase provides support for instructional materials for improving course and curriculum.

- **Presidential Awards for Excellence in Science and Mathematics Teaching** totals $4.20 million, awards two science and two mathematics teachers from each state, and each of the four jurisdictions: the District of Columbia, Puerto Rico, the Department of Defense Dependent Schools, and the United States Territories (Guam, American Samoa, the Commonwealth of Northern Marianas, and the Virgin Islands) each year.

- Other K-12 activities will be sustained at the FY 1994 level. This substantial ongoing funding will permit continued support of the Teacher Enhancement Program ($100.80 million), Instructional Materials Development ($42.45 million), Informal Science Education ($29.75 million), the K-12 programs for minorities ($14.83 million), the Young Scholars program ($11.00 million) and Teacher Preparation ($18.00 million). The Research, Evaluation and Dissemination (RED) Activity also has selected activities in research studies and evaluation supporting K-12 education in FY 1995 ($34.82 million).

Undergraduate Support

Support at the undergraduate level is $102.25 million, an increase of $2.44 million over the FY 1994 level. This support is focused primarily in the Undergraduate Education and Human Resource Development Activities. This funding also supports evaluation of undergraduate programs in the Research, Evaluation and Dissemination Activity. A description of some of the programs supported:

- **Course and Curriculum** ($22.24 million) supports the intellectual effort necessary to restructure courses and curriculum in light of current needs, new technologies, improved teaching methods, and new knowledge within and across disciplines.

- **Instrumentation and Laboratory Improvement** ($23.00 million) supports projects designed to generate new and improved approaches to laboratory and field-based instruction.

- **Advanced Technology Education (ATE)** ($11.77 million) supports improvements in advanced technological education at the national and regional level. The $2.00 million increase will go towards new centers and expansion of projects for ATE.

- Other undergraduate activities remain close to FY 1994 levels. This substantial ongoing funding will permit continued support for Faculty Enhancement ($8.00 million) and support for minority programs, such as the Alliances for Minority Participation ($27.00 million).

Graduate Support

Support at the graduate level is $63.39 million, an increase of $4.60 million over the FY 1994 level. This support is in the Graduate Education and Research Development Activity.

- **Graduate Fellowships** increases in FY 1995 to provide for modest increases in both the stipend and the cost of education allowance, and at the same time sustain the number of fellows at approximately 2,400. The **Graduate Traineeship** program will be sustained at the FY 1994 level.

Public Understanding of Science

Support for Public Understanding of Science projects remains close to the FY 1994 level of $6.00 million. This support comes from both the Elementary, Secondary, and Informal Science (ESIE) and the Research, Evaluation and Dissemination (RED) Activities.

- **Informal Science Education** in ESIE supports projects designed to provide rich and stimulating environments outside of school where individuals of all ages, interests, and backgrounds can increase their appreciation and understanding of science, mathematics, and their applications.

- **Research in Teaching and Learning** in RED focuses on public literacy in science, encompassing all ages from kindergarten through adulthood.

Additional highlights:

Following on the successes of the first Invitational Conference in February 1993, EHR will host a second conference on February 24-26, 1994, **Building the System: Making Science Education Work**. This conference continues the building of partnerships among local, state and national groups for effective systemic reform, and for the development of collaborative strategies. Successful NSF-supported projects in mathematics and science education are presented that are proving useful in systemic reform.

The second annual national conference on **Diversity in the Scientific and Technological Workforce** was held on October 28-30, 1993, in Washington, D.C. The conference was attended by more than 1,300 representatives from the Congress, colleges, universities, industry, professional associations, and federal and state agencies. Over 300 students in NSF-supported projects, as well as 200 K-12 and college students, from local areas, attended this conference.

Number of People Involved in EHR Activities

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Senior Researchers	4,540	5,330	5,420
Other Professionals	1,450	1,630	1,650
Post-Doctorates	280	340	350
Graduate Students	4,070	4,460	4,560
Undergraduate Students	4,900	6,810	6,840
K-12 Teachers	46,070	55,070	59,370
K-12 Students	11,010	12,770	12,770
Total Number of People	72,320	86,410	90,960

EHR Funding Profile

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Total Number of Awards	2,255	2,638	2,700
Statistics for Competitive Awards:			
Number	1,268	1,300	1,300
Funding Rate	25%	24%	23%
Median Annualized Award Size	$40,353	$41,000	$42,000
Average Annualized Award Size	$104,953	$108,000	$110,000
Average Duration (yrs.) \1	1.6	1.7	1.7

1\ Average Duration includes all awards.

SYSTEMIC REFORM $117,980,000

The FY 1995 Budget Request for the Systemic Reform (OSR) Activity is $117.98 million, an increase of $8.00 million, or 7.3 percent, over the FY 1994 Current Plan of $109.98 million.

(Millions of Dollars)

	FY1993 Actual	FY1994 Current Plan	FY 1995 Request	Change Amount	Change Percent
Educational System Reform	57.64	78.06	86.06	8.00	10.2%
Experimental Program to Stimulate Competitive Research	24.65	31.92	31.92	0.00	0.0%
Total, OSR	$82.29	$109.98	$117.98	$8.00	7.3%

The Systemic Reform Activity supports highly focused state, urban and rural reform efforts to improve science, mathematics, engineering and technical education and research. These programs provide catalytic support for cooperative efforts to address fundamental, sustainable changes and infrastructure development in states, cities, and rural regions. Systemic Reform also supports other efforts in mathematics and science education including activities to develop national standards.

Educational System Reform activities through the Statewide Systemic Initiatives (SSI), Urban Systemic Initiatives (USI) and the Rural Systemic Initiatives (RSI) encourage and facilitate cooperation among states, cities, rural areas, school systems, and other organizations in order to systemically impact science, mathematics, and technical education.

Experimental Program to Stimulate Competitive Research (EPSCoR) is designed to improve the scientific and technological capacity of states with less developed research infrastructure, thereby bringing participant states' science and engineering research capabilities to nationally competitive levels. EPSCoR currently operates in eighteen states and Puerto Rico. The National Science Foundation has invested over $100 million in EPSCoR during its lifetime, while states have provided over $250 million in support.

Examples of ongoing significant projects:

- The state of Louisiana has approximately 766,000 K-12 students and 50,000 K-12 teachers. Louisiana's five-year SSI award, a total of $10 million, is matched by an additional $10 million from state funds. Since the initial year of funding of the Louisiana SSI, over 1,600 teachers have received in-depth, high-quality professional development in mathematics and science. Colleges and universities that provide teacher education are undergoing major transformation and programs are being redesigned. State mathematics and science curricula and assessment frameworks are being developed and teacher certification requirements are being reviewed and modified.

- During FY 1993, all 25 cities eligible for USI awards were engaged in an intensive planning process. Each city is designing a long-term implementation plan to significantly improve its core science and mathematics instructional program.

- EPSCoR-supported researchers in the Wood Science and Engineering Research Cluster, at the University of Maine, have developed and tested stainless steel metal connector plates which will be used in the construction of two experimental timber bridges. Funding for construction of the bridges will be provided by the state of Maine.

The FY 1995 budget request includes:

- **Educational System Reform** increases by $8.00 million, or 10.2 percent, to a total of $86.06 million. The major components of this reform effort are:

Urban Systemic Initiatives (USI), begun in FY 1993, increases $6.00 million for a total of $25.00 million. The additional $6.00 million will enable some of the awardee cities initial implementation level to increase from $2.00 million per year to a maximum of $3.25 million per year. The USI-eligible cities are: Atlanta, Baltimore, Boston, Chicago, Cincinnati, Cleveland, Columbus, Dallas, Detroit, El Paso, Fresno, Houston, Indianapolis, Jacksonville, Los Angeles, Miami, Memphis, Milwaukee, New Orleans, New York, Philadelphia, Phoenix, San Antonio, San Diego, and St. Louis.

Rural Systemic Initiatives (RSI), begun in FY 1994, increases $2.00 million for a total of $3.50 million. This increase will provide one to two implementation awards to critical rural regions of the nation comprised of counties with high poverty rates and which are underserved in science and mathematics education. The awards will enable these regions to undertake systemic reform of science and mathematics education.

Statewide Systemic Initiatives (SSI), which began in FY 1991, is sustained at the FY 1994 level of $54.76 million for up to 26 ongoing awards. The awardees are eligible for up to $10.00 million for 5 years, and they provide approximately dollar-for-dollar matching funds. The following are SSI awards by year of initial funding - FY 1991: Connecticut, Delaware, Florida, Louisiana, Montana, Nebraska, North Carolina, Ohio, Rhode Island, and South Dakota; FY 1992: California, Georgia, Kentucky, Maine, Massachusetts, Michigan, New Mexico, Puerto Rico, Texas, Vermont, and Virginia; FY 1993: Arkansas, Colorado, New Jersey, New York, and South Carolina.

- **EPSCoR** is sustained at current levels after significant growth in FY 1994. At present, 18 states and Puerto Rico have active awards through the program. Since its beginning, EPSCoR has leveraged approximately 2.5-to-1 matching funds. The participants are: Alabama, Arkansas, Idaho, Kansas, Kentucky, Louisiana, Mississippi, Maine, Montana, Nebraska, Nevada, North Dakota, Oklahoma, Puerto Rico, South Carolina, South Dakota, Vermont, West Virginia, and Wyoming.

Figure 1 provides a map of the distribution of Systemic Reform support: states with Statewide Systemic Initiatives (SSI) awards, states participating in EPSCoR and the 25 cities that are eligible to participate in the Urban Systemic Initiatives (USI).

Number of People Involved in OSR Activities

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Senior Researchers	490	630	650
Other Professionals	190	200	210
Post-Doctorates	90	120	120
Graduate Students	290	370	390
Undergraduate Students	190	210	210
K-12 Teachers	1,840	2,760	3,030
K-12 Students		20	20
Total Number of People	3,090	4,310	4,630

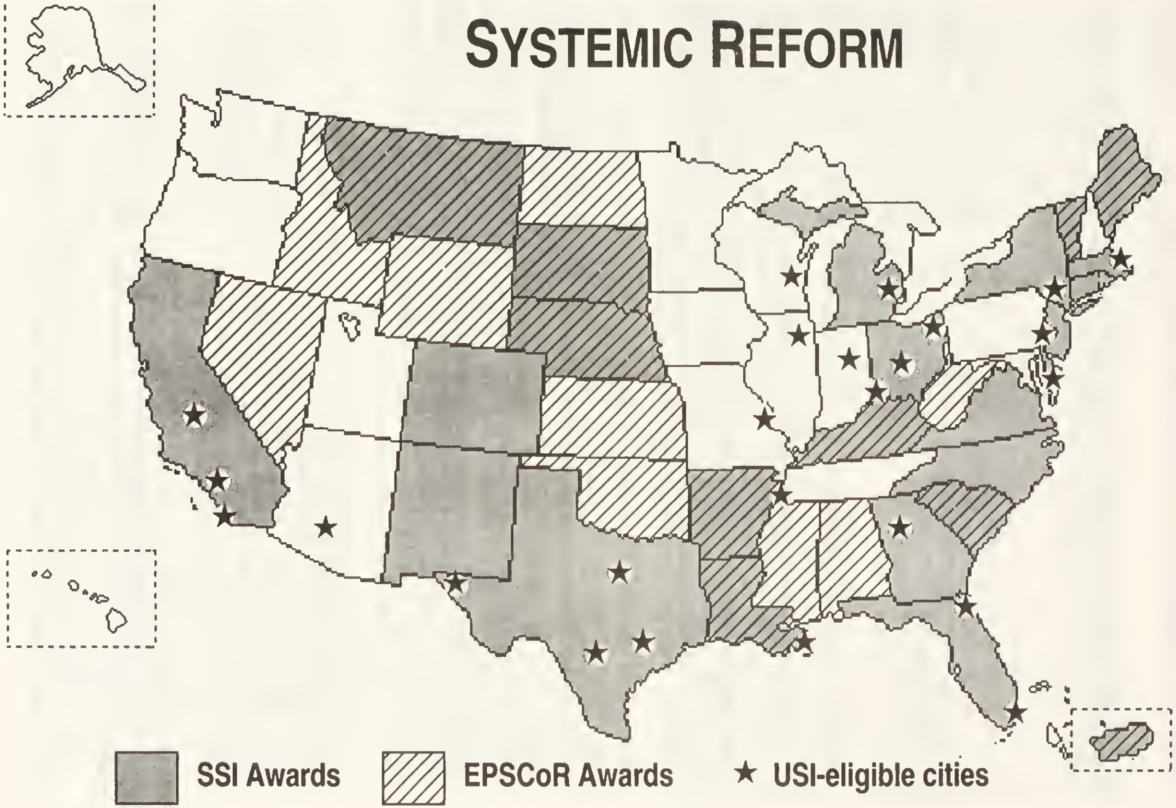


Figure 1

SYSTEMIC REFORM

ELEMENTARY, SECONDARY, AND INFORMAL EDUCATION $199,280,000

The FY 1995 Budget Request for the Elementary, Secondary, and Informal Education (ESIE) Activity is $199.28 million, an increase of $1.00 million, or .05 percent, over the FY 1994 Current Plan of $198.28 million.

(Millions of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Change Amount	Change Percent
Student Support	11.30	11.00	11.00	0.00	0.0%
Curriculum Development	40.18	44.12	45.12	1.00	2.3%
Teacher Enhancement and Development	98.59	108.16	108.16	0.00	0.0%
Informal Science Education	34.61	35.00	35.00	0.00	0.0%
Total, ESIE	$184.68	$198.28	$199.28	$1.00	0.5%

The goals of the Elementary, Secondary, and Informal Education Activity are to enable ***all students,*** pre-kindergarten to grade 12 (pre K-12), to succeed in science, mathematics and technology education, as well as promote public interest and literacy in these fields. The programs supported in this Activity accelerate progress toward meeting the National Education Goals in science and mathematics, established in 1990 by the President and the nation's governors; develop and implement high-quality instructional materials designed for the success of all students; and enhance the scientific, mathematical and pedagogical, and technical knowledge of teachers through in-service training.

The impact of ESIE programs is demonstrated as follows:

- Strengthening the abilities of the instructional workforce immediately helps to improve student performances. In Kentucky, in collaboration with a Statewide Systemic Initiatives (SSI) award, in-service teacher training is bringing standards-based mathematics to every middle school classroom. In Oakland, CA, all 1,050 elementary science teachers are learning how to use exemplary NSF-supported science curriculum materials and to develop technology topics critical to local industry.

- Effective use of technology and the media can increase the numbers of students exponentially who benefit from NSF-supported materials. ***Project Mathematics!*** videos, already viewed by 1.2 million students, earned a 1993 Silver Medal at the New York Film and Video Festival. ***Kids Network***, a curriculum project that links students and scientists all over the world is now used in over 300,000 classrooms in the United States and five foreign countries.

- An example of empowering the community and parents to be a part of the education solution is evidenced by ***Project EXCEL-MAS,*** a program for delivering bilingual math and science curriculum and materials to "at risk" Hispanic elementary and middle school students and their parents. Coalitions of community and school-based organizations link informal and formal education communities. ***The Magic School Bus Museum*** collaboration brings together seven museums to develop instructional materials, exhibits, and teacher training that will capitalize on the excitement generated by the forthcoming NSF supported Magic School Bus TV series. Special materials for youth organizations target multi-ethnic audiences.

Four major Subactivities comprise the Elementary, Secondary and Informal Education Activity: **Student Support** ($11.00 million); **Curriculum Development** ($45.12 million); **Teacher Enhancement and Development** ($108.16 million), and **Informal Science Education** ($35.00 million). Supported programs include:

- **Young Scholars** ($11.00 million), a program in Student Support involves projects with students of high potential (grades 7-12) in science, mathematics. and technology. Students are exposed to problem solving and advanced research environments to gain awareness of professional opportunities in science and technology.

- **Instructional Materials Development** ($42.45 million), a program in Curriculum Development, supports curricula, courses, materials, and assessment strategies to promote improvement of science, mathematics, and technology instruction for all ***Pre K-12 students.*** Through incorporation of curriculum standards, investigations, and hands-on experiences, its products facilitate positive long-term changes in student learning.

- **Teacher Enhancement** ($100.80 million), a program in Teacher Enhancement and Development, is one of two major federal in-service teacher education programs. Teacher Enhancement projects update and strengthen the content and pedagogical knowledge of teachers, administrators, and others, who play significant roles in providing quality science, mathematics, and technology education. Emphasis is on developing leaders who promote the professional development of their peers and assist in generating long-term school change.

- **Advanced Technological Education (ATE)** ($5.83 million), a new program starting in FY 1994, in both Curriculum Development and Teacher Enhancement and Development, supports projects that promote improvement in secondary school curricula and instruction for future technicians, especially those in high-performance advanced technologies. Benefits pertain to immediate employment or to facilitate transitions to two-year and four-year colleges and universities.

- **Presidential Awards for Excellence in Science and Mathematics Teaching** ($4.20 million), supported in Teacher Enhancement and Development, a career recognition program that demonstrates the importance of exemplary classroom instruction for science and mathematics teachers at both elementary and secondary school levels.

- **Informal Science Education** ($35.00 million), projects promote understanding of science through voluntary, self-directed, and long-term learning. Visual and object oriented projects operate through a variety of media and other organizations, e.g., TV, print, film, museums, parks, libraries, and community groups. Projects have national or significant regional impact and seek to promote linkages between informal and formal education.

The FY 1995 Budget Request includes an increment of $1.00 million to support Instructional Materials Development under the Advanced Technological Education initiative. The increase will further support improvements in the quality of courses and curricula through integration of basic science, mathematics, engineering, and instructional technologies into the underlying core program.

Number of People Involved in ESIE Activities

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Senior Researchers	2,240	2,400	2,450
Other Professionals	740	800	800
Post-Doctorates	80	80	90
Graduate Students	450	490	500
Undergraduate Students	570	610	620
K-12 Teachers	44,000	52,000	56,000
K-12 Students	7,650	7,800	7,800
Total Number of People	55,730	64,180	68,260

UNDERGRADUATE EDUCATION $83,010,000

The FY 1995 Budget Request for the Undergraduate Education (DUE) Activity is $83.01 million, an increase of $2.00 million, or 2.5 percent, over the FY 1994 Current Plan of $81.01 million.

(Millions of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Change Amount	Change Percent
Curriculum & Laboratory Development	41.56	55.01	57.01	2.00	3.6%
Teacher and Faculty Development	20.35	26.00	26.00	0.00	0.0%
Total, DUE	$61.91	$81.01	$83.01	$2.00	2.5%

The Undergraduate Education Activity contributes to the improvement of undergraduate science, mathematics, engineering and technology education by providing leadership and leveraged project support for technical colleges, two- and four-year colleges, and comprehensive and research universities. The programs seek to engage all undergraduate students in the learning of science--those who will be engineers, scientists or skilled technicians; teachers of science and mathematics; leaders of business, the professions, and government; and citizens in an increasingly technology-based society. The focus of the Activity is on reforming curricula and laboratories, upgrading instructional scientific equipment, enhancing college and university faculty and teaching, improving the undergraduate preparation of K-12 teachers, and addressing advanced technician training.

Examples of some significant ongoing projects include:

- Systemic change in the undergraduate education of future science and mathematics elementary and secondary teachers is the focus of the **NSF Collaboratives for Excellence in Teacher Preparation** program. The goal is to "get it right from the start" so that beginning teachers are well-grounded both in the disciplines and in modern teaching methods and technologies. One project in Montana involves the two state universities, three four-year colleges and six tribal colleges all participating in a multi-faceted approach to improving teacher preparation across the state. The tribal colleges and the universities are cooperating on designing classes to be delivered via distance learning techniques and instituting special projects to increase retention of students transferring from the tribal colleges. Field experiences for pre-service teachers have been redesigned to include reservation schools as model school sites.

- A major emphasis in the **Undergraduate Faculty Enhancement** program involves regional coalitions between two- and four-year college faculty, such as the coalition among molecular biologists at the University of California-Davis and faculty from several community colleges in the region. Working together, they have developed materials and incorporated knowledge of recombinant DNA methodologies into undergraduate courses directly affecting several thousand students.

- Over 250,000 college students enrolled in lower division courses have benefited from NSF's **Curriculum and Laboratory Development** program in FY 1993. Even greater impact is beginning to be seen indirectly via commercial publication and dissemination of texts, materials, and technologies. For example, a consortial project involving large and small, public and private, two- and four-year institutions led by Harvard University, is developing a textbook and materials expected to be widely adopted and used for teaching Calculus. In another project, award of a telescope for astronomy classes to a community college in Mississippi stimulated the faculty and students to build an observatory with their own hands, and has resulted in a student/faculty research publications.

The FY 1995 budget request includes:

- **Advanced Technological Education (ATE)** ($11.77 million), an increase of $2.00 million over the FY 1994 Current Plan. ATE, a new program in FY 1994, promotes exemplary improvements in advanced technological education at the national and regional level through the support of curriculum development and program improvement. Projects and centers are led primarily by two-year colleges, in cooperation with secondary schools, colleges and universities, business, and industry. Coordination at the collegiate and school levels is achieved through close cooperation between the Undergraduate Education Activity and the Elementary, Secondary and Informal Science Education Activity. The increase will expand the number of centers and permit the support of additional projects with regional or national impact.

- **Course and Curriculum Development** ($22.24 million). Course and Curriculum Development projects envision major changes at the undergraduate level with potential national impact, resulting in widely disseminated products. The current emphasis is on freshmen and sophomore courses. New systemic changes, begun in FY 1994, in selected undergraduate curricula at all levels will be continued.

- **Instrumentation and Laboratory Improvement (ILI)** ($23.00 million). The ILI program supports highly leveraged projects for the development of new or improved approaches to laboratory field-based courses at all undergraduate levels of science, mathematics, engineering, and technology.

Support for **Teacher and Faculty Development** of $26.00 million will include:

- **Faculty Enhancement** ($8.00 million). This program enables faculty members, teaching undergraduates, at all types of institutions to gain experience with new experimental techniques and teaching methods in their fields and to incorporate them into undergraduate instruction. National and regional projects feature hands-on workshops with follow-up activities. The projects also serve as a vehicle for dissemination and adoption of model courses and materials, such as those developed with support from other programs in the Activity.

- **Teacher Preparation** ($18.00 million). This program supports comprehensive systemic changes in the undergraduate education of future teachers, which includes the NSF Collaboratives for Excellence in Teacher Preparation. Collaboratives bring together faculty in science, mathematics, engineering and technology, education from several colleges and universities and practicing teachers to work with state and local education agencies for designing the best college preparation for future teachers. In addition, the program supports other individual projects that improve the preparation of future teachers in science, mathematics, and technology.

Number of People Involved in DUE Activities

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Senior Researchers	740	980	990
Other Professionals	140	180	190
Post-Doctorates	10	20	20
Graduate Students	220	300	310
Undergraduate Students	280	360	370
K-12 Teachers	200	250	280
K-12 Students	100	100	100
Total Number of People	1,690	2,190	2,260

GRADUATE EDUCATION AND RESEARCH DEVELOPMENT $71,060,000

The FY 1995 Budget Request for the Graduate Education and Research Development (GERD) Activity is $71.06 million, an increase of $4.60 million, or 6.9 percent, over the FY 1994 Current Plan of $66.46 million.

(Millions of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Change Amount	Change Percent
Graduate Student Support	77.37	58.79	63.39	4.60	7.8%
Faculty Development	8.04	7.67	7.67	0.00	0.0%
Total, GERD	$85.41	$66.46	$71.06	$4.60	6.9%

* Includes $22.8 million carryover from FY 1992

The Graduate Education and Research Development Activity focuses on developing a diverse pool of individuals educated at the advanced levels of science and engineering to meet the educational, scientific and technological needs of the nation. This objective is addressed through the Graduate Student Support program, using both fellowships and traineeship mechanisms, and the Faculty Development program which primarily is focused on advancing the careers of women in science and engineering.

Graduate Student Support program includes both Graduate Fellowships and Graduate Traineeships. Graduate Fellows and Minority Graduate Fellows are the nation's most outstanding students to undertake graduate study in the fields of science, mathematics and engineering at the institutions of their choice. Graduate Traineeships supports the efforts of a wide variety of colleges and universities to increase the Ph.D. production rate in critical and emerging cross-disciplinary areas of science and engineering.

The **Faculty Development** Program provides outstanding women faculty with opportunities for accelerated advancement into tenured and tenure-track academic positions. Through the Visiting Professorships for Women (VPW) program support is given to experienced women scientists and engineers who serve as visiting faculty members at host institutions. While increasing the visibility of women scientists in the academic environment, the program also encourages other women to pursue careers in science and engineering.

In April 1993, twelve former Graduate Fellows were elected to the National Academy of Sciences, bringing to over 200 the total of former Fellows among Academy members today.

Gail Mahood, now an associate professor at Stanford University, held a Visiting Professorship for Women grant at the University of Michigan. There she conducted key research in the study of volcanoes. While at the University of Michigan, she was significantly involved in a departmental initiative to improve the participation of female undergraduate and graduate students.

A Graduate Research Traineeship award to the University of Florida will provide support in machine tool research, a rapidly developing area critical to maintaining our nation's leadership in creating advanced technologies. In addition to covering diverse interdisciplinary research areas, the program offers promise of future industrial benefit by providing internships in industry and foreign laboratories.

- **Graduate Student Support** will increase $4.60 million to total $63.39 million. This increase will sustain the current level of active Graduate Fellows and Graduate Minority Fellows at 2,400 during 1994-1995, and will increase the fellowship stipend from $14,000 to $14,400 and the cost-of-education allowance from $7,500 to $8,600. Approximately 350 of these Fellows will be members of minority groups. Graduate Research Traineeships will be supported at $9.00 million, unchanged from FY 1994. These funds will support the out-year commitments for about 360 traineeship positions awarded in prior years. No new traineeship positions are planned.

- **Faculty Development** will be sustained at $ 7.67 million. Visiting Professorships for Women ($2.67 million) will enable women scientists and engineers to further develop their research careers. Faculty Awards for Women ($5.00 million) will support the fourth year of the Foundation's five-year commitment for 100 mid-career women faculty to facilitate their advancement to positions of academic leadership.

Number of People Involved in GERD Activities

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Senior Researchers	110	120	120
Other Professionals	20	20	20
Post-Doctorates	30	30	30
Graduate Students	2,660	2,740	2,800
Undergraduate Students	240	240	240
Total Number of People	3,060	3,150	3,210

HUMAN RESOURCE DEVELOPMENT $66,390,000

The FY 1995 Budget Request for the Human Resource Development (HRD) Activity is $66.39 million, sustained at the same level as the FY 1994 Current Plan.

(Millions of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Change Amount	Change Percent
Precollege Education	14.87	14.83	14.83	0.00	0.0%
Undergraduate Student Support	19.17	25.51	25.51	0.00	0.0%
Institutional Support	12.59	15.45	15.45	0.00	0.0%
Model and Experimental Programs	2.98	10.60	10.60	0.00	0.0%
Total, HRD	$49.61	$66.39	$66.39	$0.00	0.0%

The Human Resource Development Activity supports systemic and comprehensive activities to broaden the participation of groups who are underrepresented in fields of science, mathematics and engineering. These programs are designed to make a significant difference over the next decade in the number of minorities, women and girls, and persons with disabilities that enter and succeed in science, mathematics and engineering careers. In addition, the programs are directed at stimulating systemic change in education and research at institutions that have significant numbers of these underrepresented groups involved in activities at the precollege level through career development.

- There are three K-12 programs in HRD which provide systemic and comprehensive activities that increase the educational achievement of over 200,000 students, both directly and indirectly. There are 56 Summer Science Camps projects; nine Partnerships for Minority Student Achievement projects; and 14 Comprehensive Regional Centers for Minorities projects. The Regional Center project at Loyola University in Chicago won the prestigious Anderson Medal of the Business-Higher Education Forum for building educational excellence through exemplary business-higher education-public school alliances.

- Undergraduate programs include: Research Careers for Minority Scholars and Alliances for Minority Participation supporting over 45,000 students, both directly and indirectly, by providing systemic, comprehensive, and research-based experience. The California Alliance at Irvine, with a partnership of 25 baccalaureate producing institutions, has implemented: bridge programs among K-12 and colleges and universities, and community colleges to four-year colleges; computer-based learning laboratories; curriculum enhancement workshops; research and service assistantships; the development of a student textbook for technical writing; and student-conducted research symposia.

- The reorganization and expansion of the Model and Experimental Programs for Women and Girls in FY 1993 focuses attention on the issue of underrepresentation of women and girls in science, engineering, and mathematics, as well as, gender equity issues. The Programs established 16 collaborative and systemic model projects in FY 1993. One collaborative model project by the Cranbrook Institute of Science in Michigan brings together more than 75 professionals and associations to offer hands-on activities at the science center for girls in grades K-8 supplemented by support activities for parents and a conference for teachers and youth organization leaders.

- The Model and Experimental Programs for Persons with Disabilities were formally organized in FY 1993. The Programs have had an impact on the development of mathematics symbology, textbooks for K-12 and undergraduate mathematics, and facilitation awards for research. This program supports a Tactile Symbology to Augment Braille Mathematics project that developed an innovative approach of presenting raised-line mathematics with Braille letters and numbers to permit blind researchers at Oregon State University to preserve the spatial format of mathematical equations.

The FY 1995 budget request is sustained at the FY 1994 level and includes:

- **Precollege Education** ($14.83 million). The major components of this Subactivity are:
    - **Summer Science Camps** ($5.51 million) will support 70 continuing grants that motivate minority students entering grades seven through nine to select careers in science, mathematics and engineering fields.
    - **Partnerships for Minority Student Achievement** ($5.61 million) will support nine continuing awards that allow school districts with sizable minority enrollments to implement systemic activities focusing on improving the quality of education for students in K-12.
    - **Comprehensive Regional Centers for Minorities** ($3.71 million) will continue support for six existing Centers and initiate four new ones. New awards will replace those ending in FY 1994. These Centers provide comprehensive and systemic activities on a regional basis to enhance the educational experiences of students and teachers.
- **Undergraduate Student Support** ($25.51 million). The major components of this Subactivity are:
    - **Research Careers for Minority Scholars** ($6.40 million) will support up to 20 new awards that were recommended in FY 1994 and 20 new awards from the FY 1995 competition. All new awards will replace those that end in FY 1994. These awards provide quality research and related educational experiences for nearly 2,000 of the most talented minority undergraduates in all regions of the nation. In addition, 13 continuing grants will be supported.
    - **Alliances for Minority Participation** ($19.11 million) will provide continuing support for 15 existing projects and the initiation of four new starts. These alliances maximize the production of baccalaureate degrees earned by minorities in science, mathematics and engineering by utilizing the knowledge, resources, and capabilities of a broad range of organizations in the federal, industrial, and private sectors.
- **Institutional Support** ($15.45 million). The major components of this Subactivity are:

    Research Improvement in Minority Institutions ($4.97 million) will support 17 new projects and five continuing projects that strengthen the faculty and student research capabilities and environments of institutions that have large minority student enrollments.

    Minority Research Centers of Excellence ($7.98 million) will continue support for eight existing Centers that serve as regional hubs for conducting competitive research at the most productive minority institutions, and producing minority doctoral students in science, mathematics and engineering fields.

    Minority Institutions for Excellence ($2.50 million) will continue collaborative support with the Foundation's research directorates for several minority institutions that have strong track records of producing large numbers of minority students who earn baccalaureate degrees in science, mathematics, and engineering disciplines.
- **Model and Experimental Programs** ($10.60 million). A large budget increase in this Subactivity in FY 1994 allowed the reorganization and implementation of three major program strands in the components for Women and Girls and Persons with Disabilities. The requested level funding for FY 1995 will permit the continuation of FY 1994 restructuring actions. The major components are:
    - **Programs for Women and Girls** ($7.10 million) will continue to implement activities that increase the participation of women and girls in science and engineering through short-term interventions such as Model Projects, and long-term activities in Experimental Projects. These projects focus on improving the climate for women and girls in the science, mathematics, and engineering workplace.

- **Programs for Persons with Disabilities** ($3.50 million) will increase the participation of individuals with disabilities in science, mathematics, and engineering education and research activities. Emphasis will be placed on experimental projects that build and strengthen alliances between higher education, precollege educational systems, business and industry.

Number of People Involved in HRD Activities

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Senior Researchers	690	900	900
Other Professionals	250	320	320
Post-Doctorates	40	50	50
Graduate Students	310	400	400
Undergraduate Students	3,580	5,350	5,350
K-12 Teachers	30	60	60
K-12 Students	3,260	4,850	4,850
Total Number of People	8,160	11,930	11,930

RESEARCH, EVALUATION AND DISSEMINATION $48,280,000

The FY 1995 Budget Request for the Research, Evaluation and Dissemination (RED) Activity is $48.28 million, an increase of $800,000, or 1.7 percent, over the FY 1994 Current Plan of $47.48 million.

(Millions of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Change Amount	Change Percent
Research	15.65	14.39	13.44	(0.95)	(6.6%)
Evaluation	5.64	8.97	10.27	1.30	14.5%
Dissemination and Technology Utilization	19.87	24.12	24.57	0.45	1.9%
Total, RED	$41.16	$47.48	$48.28	$0.80	1.7%

The Research, Evaluation and Dissemination (RED) Activity was formed in 1992 to integrate the research, evaluation and dissemination components of the Education and Human Resources (EHR) effort to improve science, mathematics, engineering and technical education.

Research supports the collection and analysis of data and the conduct of studies and analysis to provide a basis for the development of educational policy. The Studies & Indicators program focuses on policy-oriented research. Advancing fundamental knowledge about students, teachers, and classrooms forms the core of the Research in Teaching and Learning (RTL) program.

Evaluation's primary objective is to initiate, design and carry out systematic formative and summative evaluations of the science, mathematics, engineering, and technology education initiatives of NSF and to provide leadership and coordination in evaluating corresponding initiatives in other federal agencies.

Dissemination and Technology Utilization program encompasses basic and applied research, supported by the Applications of Advanced Technologies (AAT) program and Networking Infrastructure for Education (NIE), a joint program with the Computer and Information Science and Engineering Directorate, and the Dissemination Program.

Significant RED contributions in FY 1993 include:

- The Congressionally-mandated Indicators of Science and Mathematics Education 1992 (first edition) provides analytical and policy support to EHR. This report documents trends in student achievement, science and mathematics teachers and curricula, and school-based and higher education preparation for careers in science. It has been used and cited by policy makers, the media, and researchers.

- Evaluation reports on the **Visiting Professorships for Women (VPW)** program and the Undergraduate **Faculty Enhancement** program were completed. In addition, a User-Friendly Handbook for Project Evaluation was developed and employed in a series of workshops with NSF awardees and expert evaluators. The current schedule of education program evaluations include eight that continue into FY 1994 and expansion of the EHR Impact Database for monitoring and evaluative purposes.

- Three projects, headed respectively by an atmospheric scientist, an education researcher, and a cognitive scientist, are collaborating in the area of atmospheric data, using up to the minute, localized information from the Weather Service. As a result of this collaboration the Michigan Department of Education has adopted the software, and through the University Education Cable System, the atmospheric scientist is demonstrating for teachers how to include current weather data in science and mathematics classroom activities.

The FY 1995 budget request includes:

- **Evaluation** program will increase $1.30 million, or 14.5 percent, to total $10.27 million. This increase reflects the extensive evaluation activity continuing from FY 1993 of evaluating NSF's science, mathematics, engineering and technology education initiatives and coordinating the evaluation of corresponding initiatives in other federal agencies. FY 1994 has 12 new evaluations beginning. A robust schedule of new and ongoing program evaluations, which will include two systemic initiatives, is projected for FY 1995.

- **Dissemination and Technology Utilization** will increase $450,000 to total $24.57 million. The Applications of Advanced Technologies (AAT) program, participating in the **High Performance Computing and Communications/IITA** initiative, supports high-risk projects that help advance, through new technologies, the teaching and learning of science, mathematics, engineering, and technology at all educational levels. The Dissemination program sponsors video workshops, exhibits installed at national conferences, and disseminates publications related to EHR activities.

- **Research** decreases $950,000 to total $13.44 million. This decrease reflects a redirection of resources to be used for higher priority programs in Evaluation and the Applications of Advanced Technologies (AAT).

Number of People Involved in RED Activities

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Senior Researchers	270	300	310
Other Professionals	110	110	110
Post-Doctorates	30	40	40
Graduate Students	140	160	160
Undergraduate Students	40	40	50
Total Number of People	590	650	670

ACADEMIC RESEARCH INFRASTRUCTURE $55,000,000

The FY 1995 Budget Request for the Academic Research Infrastructure (ARI) Activity is $55.00 million, a decrease of $45.00 million, or 45.0 percent, from the FY 1994 Current Plan of $100.00 million. This $55.00 million request is the same level that was requested in Fiscal Year 1994.

(Millions of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Change Amount	Change Percent
Academic Research Facilities	37.28	50.00	27.50	-22.50	-45.0%
Academic Research Instrumentation	12.47	50.00	27.50	-22.50	-45.0%
Total, ARI	$49.75	$100.00	$55.00	-45.00	-45.0%

The Academic Research Infrastructure Activity is designed to improve the condition of research equipment and facilities in our Nation's academic institutions. The Activity consists of two components.

- Facilities Modernization, which provides support for the improvement of research and research training facilities.
- Instrumentation, which provides support for the acquisition or development of research equipment.

The Activity responds to needs identified by the academic science and engineering community for research instrumentation that is not routinely available through other NSF programs and for improving the Nation's research and training facilities.

As part of its ongoing role in collecting data on the needs of the U.S. research enterprise, NSF is conducting a survey of the need for facilities modernization at the 525 universities and colleges at which the greatest amount of scientific research is being conducted. This new survey will update our current understanding of the status of research facilities, which is based on a similar 1992 survey which indicated that 23 percent of the building space assigned to research activities was in need of limited repair to enhance their utility, an additional 13 percent needed renovation or repair before they could be used effectively, and an additional 3 percent needed to be replaced completely. The new survey will also investigate the need for new construction, as well as repair and renovation; the results of this new survey are currently scheduled to be reported to Congress in September of 1994.

A survey of instrumentation needs at U.S. universities, colleges, and other research institutions indicated that in 1992 only 16 percent of their research units had instrumentation that could be considered "excellent" in its capability to meet the needs of the research staff. Approximately half of the units considered their instrumentation as only "adequate" and 31 percent rated their instrumentation as "insufficient".

In F Y 1995, NSF is requesting $55.00 million for Academic Research Infrastructure; the same amount which was requested in FY 1994 and will be split evenly between facilities and instrumentation. Because the academic infrastructure problem is so pervasive, it cannot be adequately addressed by one agency acting alone. Only with the concerted cooperative effort of every agency that funds academic research, and with the support of Congress, can the federal government begin to address the large scale modernization and instrumentation requirements of our science laboratories and classrooms. The $55.00 million requested would support meritorious proposals submitted by the FY 1994 proposal solicitation deadline but held over for funding with FY 1995 funds. New proposals would not be solicited in FY 1995. NSF feels that $55 million is sufficient to allow the continued upgrading and improvement of research facilities and instrumentation at academic institutions while maintaining our traditional role in the research community.

Funding Profile: Facilities

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Total Number of Awards	57	100	50
Statistics for Competitive Awards:			
Number	57	100	50
Funding Rate	33%	25%	20%
Median Annualized Award Size	$232,608	$250,000	$200,000
Average Annualized Award Size	$320,890	$350,000	$300,000
Average Duration (yrs.)	NA	NA	NA

Funding Profile: Instrumentation

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Total Number of Awards	9	35	23
Statistics for Competitive Awards:			
Number	9	35	23
Funding Rate	NA	NA	NA
Median Annualized Award Size	$419,251	$450,000	$400,000
Average Annualized Award Size	$521,129	$550,000	$500,000
Average Duration (yrs.)	NA	NA	NA

MAJOR RESEARCH EQUIPMENT $70,000,000

The FY 1995 Budget Request for Major Research Equipment (MRE) is $70.00 million.

(Millions of Dollars)

Program Element	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Change Amount	Change Percent
Major Research Equipment	$34.07	$52.00	$70.00	$18.00	34.6%

1/ Major Research Equipment is funded through the Research and Related Activities account in FY 1993 and 1994. A new Major Research Equipment (MRE) Account is proposed to be established beginning in FY 1995.

The Major Research Equipment Account is established to provide funding for the construction of major research facilities that provide unique capabilities at the cutting edge of science and engineering. Formerly funded through the Research and Related Activities (R&RA) appropriation, these construction projects totaled $34.07 million in FY 1993 and $52.00 million in the FY 1994 Current Plan. The FY 1995 request of $70.00 million represents an $18.00 million increase, or 34.6 percent, over the FY 1994 Current Plan for these items.

Projects supported by this Account will push the boundaries of technological design and will offer significant expansion of opportunities, frequently in totally new directions, for the science and engineering community. Operations and maintenance, once construction of the basic facility is completed, will be funded through the R&RA account.

Two projects currently comprise the Major Research Equipment Account: the Laser Interferometer Gravitational Wave Observatory (LIGO) and the Gemini Telescopes, twin eight meter telescopes in the northern and southern hemispheres being built through an international partnership.

Funding for these projects is summarized below:

(Millions of Dollars)

	FY 1993 Estimate	FY 1994 Estimate	FY 1995 Estimate
Laser Interferometer Gravitational Wave Observatory	$20.00	$35.00	$50.00
Gemini 8-Meter Optical/Infared Telescopes	$14.07	$14.00	$20.00

A third project, the construction of a revamped Green Bank Telescope (GBT) is currently underway under the auspices of the National Radio Astronomy Observatory (NRAO). Construction of the GBT is fully funded and proceeding using funds appropriated in a prior year. No additional funds will be requested for construction of the GBT. This project is also described below.

Construction of the National High Magnetic Field Laboratory (NHMFL), initiated in FY 1991, is near completion. Currently funded in the Mathematical and Physical Sciences (MPS) Major Research Equipment Subactivity, it will be funded in the MPS Materials Research Subactivity beginning in FY 1995. (See the MPS and Materials Research Subactivity for detail.)

LIGO

An increment of $15.00 million In FY 1995 to a total of $50.00 million will permit the project to progress toward completion of construction and a transition to operations during FY 1998. (Additional funding for research and development is provided through the Physics Subactivity of the Mathematical and Physical Sciences Activity in the R&RA account.)

Gravitational waves are propagating ripples in the fabric of space-time, as predicted by Einstein's theory of gravitation. They are produced by accelerations of bulk matter or by oscillations of strong vacuum gravitational fields (such as in the collision of black holes). The primary objectives of the search for gravitational waves include: tests of the dynamical features of Einstein's theory of gravitation; and study of the properties of intense gravitational fields.

Gravitational waves are expected to distort space as they pass. They will be detected by measuring the extremely small oscillations they produce between separated masses. This requires the use of innovative instrumentation of unprecedented sensitivity. Scientific teams have spent the last decade building prototypes to demonstrate the needed technologies in lasers, optics, seismic isolation suspensions, and vacuum.

LIGO consists of two 4-km L-shaped facilities to be located at Hanford, Washington, and Livingston, Louisiana. Two identical, but widely separated, detectors are needed for the fundamental physics experiments of directly detecting gravitational waves and gathering data on their sources. To go further and locate the direction of astronomical sources of gravitational wave signals, four geographically separate but technically compatible detectors are required. A memorandum of understanding for joint cooperation on research and technology development has been signed with the VIRGO project, a French and Italian collaboration for a LIGO-type facility, that will greatly enhance the capabilities of both projects.

LIGO moved beyond the planning stage into construction in FY 1992. At this time, an access agreement for use of the Hanford site has been completed with the Department of Energy, and the environmental assessment has been completed with a finding of no significant environmental impact. At the Livingston site, land acquisition negotiations are in progress. Industrial planning for the necessary vacuum system has been initiated, with a subcontract for beam tube design and qualification awarded to Chicago Bridge and Iron. A prototype interferometer design is in operation and is used in ongoing research and development for the initial LIGO interferometer.

Milestones for the project are in three basic categories: civil construction, design and installation of the vacuum system, and design and installation of the interferometer. Their attainment depends on progress in technology development and sound management within the LIGO project, and on appropriate funding schedules.

FY 1994 Milestones:

Civil Construction:	access to the Livingston site; initiation of site development at both sites; tube slab acceptance at the Hanford site; selection of the building design contractor.
Vacuum System:	final design review for the beam tube; beam tube qualification test review; major vacuum equipment RFP.

FY 1995 Milestones:

Civil Construction:	tube slab acceptance at the Livingston site; building designs completed.
Vacuum System:	beam tube installed/ accepted at Hanford site; vacuum equipment final design review.
Interferometer:	validate phase noise capability.

FY 1996 Milestones:

Civil Construction: tube cover accepted at both sites;
building completed/accepted at both sites.
Vacuum System: beam tube installed/accepted at Livingston site.
Interferometer: demonstrate laser/CDS interface;
freeze length sensing servo design;
select data analysis algorithm.

FY 1997 Milestones:

Vacuum System: vacuum equipment installed/accepted at Livingston;
facility ready/accepted at Livingston.
Interferometer: initiate interferometer integration.

Start LIGO Pre-Operations Phase.

FY 1998 Milestones:

Vacuum System: vacuum equipment installed/accepted at Hanford;
facility ready/accepted at Hanford.
Interferometer: interferometer installation complete at Livingston.

FY 1999 Milestones:

Interferometer: interferometer installation complete at Hanford.

Completion of construction is expected in 1997, with interferometer installation to be completed in 1999. First scientific observations will start in 2001. Operations costs are estimated to be $12.00 million per year.

Current estimates for funding LIGO construction are as follows:

	(Millions of Dollars)						
	FY92	FY93	FY94	FY95	FY96	FY97	Total
LIGO	$15.9	$20.0	$35.0	$50.0	$55.0	$55.0	$230.9

Gemini

An increment of $3.00 million in FY 1995 to a total of $20.00 million in FY 1995 will permit the international partnership to move forward according to currently planned schedules. The total budget for the two 8-meter telescopes is $176.00 million, of which NSF is providing $88.00 million with five other countries providing the remainder. The formal agreement among the U.S., the United Kingdom, and Canada has been signed, and funds from the partners are flowing to the project. The participation of Chile, Argentina, and Brazil assures full 50 percent funding from the international partners.

Astronomers need to resolve important questions about the age and rate of expansion of the universe, its overall topology, the epoch of galaxy formation, the evolution of galaxies once they are formed, and the formation of stars and planetary systems. It is now possible to build a new generation of optical/infrared telescopes with significantly larger aperture (8-meter diameter) than existing instruments that will provide better sensitivity and spectral and spatial resolution. Technological advances in a number of key areas of telescope construction and design will allow these instruments to take advantage of the best performance the atmosphere will allow.

The Gemini Telescopes Project will construct two 8-meter telescopes, one in the northern and one in the southern hemisphere, in Hawaii and Chile, respectively. The Hawaiian telescope will be optimized for infrared observations. The Project is an international collaboration with the United Kingdom, Canada, Chile, Argentina and Brazil.

A selection for the subcontractor on the casting of the primary mirror was made in FY 1993. The primary mirror assembly preliminary design review took place in December, 1993. No serious technical problems were identified with the meniscus mirror approach selected by the project. Casting of the ultra-low-expansion glass for the first mirror blank is well underway.

Milestones for Gemini construction, as shown below, depend on progress in technology development and sound management within the Gemini project, and on appropriate funding schedules on the part of all the international partners.

FY 1994 Milestones:

place the contract for primary mirror polishing;
award the contract for construction of the enclosure for Hawaii;
start of construction in Hawaii;
award telescope fabrication contract.

FY 1995 Milestones:

complete road construction in Chile;
complete foundations in Hawaii and Chile;
award coating plan contract.

FY 1996 Milestones:

complete control system simulator.

FY 1997 Milestones:

complete enclosure in Hawaii;
complete functional control system;
deliver telescope structure in Hawaii;
complete polishing primary mirror, Hawaii.

FY 1998 Milestones:

deliver specification control system;
complete coating plant site acceptance, Hawaii;
install primary mirror, Hawaii;
install acquisition guiding unit, Hawaii;
install chopping secondary assembly, Hawaii;
FIRST LIGHT, Hawaii.

FY 1999 Milestones:

accept first instrument, Hawaii;
complete enclosure, Chile;
deliver telescope structure, Chile;
complete coating plant site acceptance, Chile;
complete polishing primary mirror, Chile.

FY 2000 Milestones:

acceptance of control system, Hawaii;
hand over of operations, Hawaii;
install acquisition guiding unit, Chile;
install primary mirror, Chile;
install chopping secondary assembly, Chile;
FIRST LIGHT, Chile.

FY 2001 Milestones:

final acceptance of first instrument, Chile;
acceptance of control systems, Chile;
hand over of operations, Chile.

First Light on Mauna Kea is scheduled for July, 1998, with the Chilean telescope following two years later. Operations costs are estimated at approximately $9.00 million per year for both telescopes. These costs will be shared by the partners in the same ratio as construction costs.

Current estimates for the U.S. funding for Gemini construction are as follows:

(Millions of Dollars)

	FY91	FY92	FY93	FY94	FY95	FY96	Total
GEMINI	$ 4.0	$12.0	$14.0	$17.0	$20.0	$21.0	$88.0

Green Bank Telescope

The new Green Bank Telescope (GBT) will be a 100-meter class, high-quality, single-dish instrument capable of observing at wavelengths from a few meters to at least 7 millimeters, with a possibility that the short-wavelength range will extend to 3 millimeters. It will replace and surpass the 100-meter radio telescope at Green Bank, West Virginia, which collapsed in November, 1988. Total funding for the GBT was $74.5 million, appropriated in a prior year.

When completed, the GBT will be the largest steerable single dish radio telescope in the world. Its unblocked aperture will greatly improve the sensitivity, and its design will also allow much better image identification. The active control of the surface, together with superior panel quality, will allow much improved source imaging at high frequencies.

The telescope is expected to have significant impact on several areas of astronomical science. For example, in solar physics multifrequency imaging of active regions and of the undisturbed chromosphere/corona will improve understanding of solar activity. For pulsars, the high sensitivity and full sky coverage will dramatically increase the data base for globular clusters and improve timing accuracy. In addition, the GBT will allow the determination of the molecular content of galaxies in their early stages. Other areas of impact include measurements of the total mass of the galactic disk, searches for rare objects, and very long base line interferometry (VBLI) including use in conjunction with space-based dishes.

1992-1993 Milestones:

Completion of the 210-foot diameter track on which the telescope rotates;
Completion of the derrick crane to be used to erect the alidade (the lower portion of the telescope that rotates on the circular tract and supports) ;
Wheels on which the telescope runs on the track were put in place;
Completion of alidade.

1994 Milestones :

Begin elevation structure, with construction of the elevation shaft and wheel;
Completion of reflector box structure, portions of the counter-weight, and the feed arm.

1995 Milestones:

Back-up structure assembled on the telescope during the spring and summer;
Reflector panel installation is to be completed during the fall;
Antenna completion is scheduled for December, 1995.

SALARIES AND EXPENSES $130,720,000

The FY 1995 Budget Request for the Salaries and Expenses (S&E) is $130.72 million, an increase of $12.42 million, or 10.5 percent, over the FY 1994 Current Plan of $118.30 million. The requested level fully funds our staffing ceiling of 1,243 full-time equivalents (FTEs), permits effective program management and continues the investment in information technology for administrative processes.

(Millions of Dollars)

	FY 1993 Actuals	FY 1994 Current Plan	FY 1995 Request	Change Amount	Change Percent
Personnel Compensation & Benefits	**$79.48**	**$80.75**	**$87.67**	**$6.92**	**8.6%**
Travel	2.33	3.00	3.49	0.49	16.3%
Space Rental	9.12	16.40	17.10	0.70	4.3%
Telephone, Telegraph and Postage	3.29	3.30	3.40	0.10	3.0%
ADP Operations and Equipment	9.88	8.37	11.59	3.22	38.5%
Other General Operating Expenses	6.74	6.48	7.47	0.99	15.3%
Subtotal, General Operating Expenses	**31.36**	**37.55**	**43.05**	**5.50**	**14.6%**
Total	**$110.84**	**$118.30**	**$130.72**	**$12.42**	**10.5%**
FULL-TIME EQUIVALENT CEILING	1,197	1,203	1,243	40	3.3%

The National Science Foundation is organized into seven program directorates; two administrative units; six staff offices which comprise the Office of the Director; the Office of Inspector General; and, the National Science Board Office, which provides analytical support to the National Science Board and coordinates its activities with staff throughout the Foundation. The Salaries and Expenses appropriation includes funds for staff salaries, benefits, travel, rent, equipment, administrative contractual services, supplies, equipment, and other operating expenses necessary for program management of NSF's research and education activities. Costs associated with the repayment of relocation expenses to GSA are included in a separate appropriation request. Expenses of the Office of the Inspector General are also justified elsewhere in this budget document.

Staffing

During the last decade, the Foundation's budget levels and the quantity and complexity of its workload have increased dramatically, while the staffing levels required to manage this workload have remained static. In FY 1983, the Foundation's budget level was $1.09 billion and its staffing level was 1,200 FTEs. A decade later, in FY 1993, NSF's budget level had almost tripled to $2.75 billion while the FTE level had remained virtually unchanged at 1,197 FTEs. During that same period, the Foundation's workload, as measured by the number of science and engineering proposals received, more than doubled.

In order to address the imbalance between expanded program activity and staffing levels and to manage and administer NSF's programs responsibly, the Foundation continues to emphasize productivity increases, including continued implementation of new electronic technologies to improve business practices in proposal processing and review, as well as continued utilization of visiting scientists and engineers, to keep pace with a greater and more complex workload.

The Foundation's FY 1995 staffing request is 1,243 FTEs. The requested staffing level will allow the Foundation a modest 4% staffing increase over its FY 1993 actual staffing level of 1,197 FTEs and will enable NSF to provide the required management and oversight of its programs.

NSF STAFFING
(Full-time Equivalents)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Estimate	Change
Biological Sciences	111	111	115	4
Budget, Finance, and Awards Management	122	122	122	0
Computer and Information Science and Engineering	60	60	65	5
Education and Human Resources	123	123	132	9
Engineering	114	114	120	6
Geosciences	93	93	97	4
Information and Resources Management	164	167	167	0
Mathematical and Physical Sciences	118	118	123	5
Social, Behavioral and Economic Sciences	135	135	137	2
Staff Offices of the Director	93	93	93	0
Office of Polar Programs	46	48	50	2
Coops/Student Aids	18	19	22	3
Total	1,197	1,203	1,243	40

Personnel Compensation and Benefits

Personnel Compensation and Benefits (PC&B) is the single largest component of the Salaries and Expenses appropriation, accounting for approximately two-thirds of total S&E resources. Personnel Compensation and Benefits costs for FY 1995 total $87.67 million, an increase of $6.92 million over the FY 1994 Current Plan level. The amount requested for PC&B in FY 1995 fully supports the requested FTE level.

The primary elements of this increase are:

- an additional $1.43 million to fully fund the FY 1994 authorized FTE ceiling in FY 1995.
- an additional $2.38 million to support the requested staffing increase of 40 FTEs over the FY 1994 approved ceiling level.
- $2.07 million for comparability pay increases.
- $1.04 million to pay for benefits increases .

PERSONNEL COMPENSATION AND BENEFITS

(Thousands of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Estimate	Change Amount	Change Percent
Full Time Equivalent	64,574	65,250	71,080	5,830	8.9%
Other Personnel Compensation	2,280	2,500	2,550	50	2.0%
NSB and Advisors	248	250	250	0	0.0%
Subtotal, Personnel Compensation	**$67,102**	**$68,000**	**$73,880**	**$5,880**	**8.6%**
Personnel Benefits					
Employer Contributions:					
Health Insurance. Retirement, FICA, etc	12,239	12,600	13,640	1,040	8.3%
Other Personnel Benefits	137	150	150	0	0.0%
Subtotal, Personnel Benefits	**$12,376**	**$12,750**	**$13,790**	**$1,040**	**8.2%**
TOTAL, PERSONNEL COMPENSATION AND BENEFITS:	**$79,478**	**$80,750**	**$87,670**	**$6,920**	**8.6%**

Travel

As the nature of the Foundation's programs continues to become more interdisciplinary, and with an increased number of state, local, and industrial partnerships, there is a resulting need for additional NSF coordination, oversight, and evaluation of program activity. It is critical that NSF staff maintain a presence with new and emerging disciplines and partnerships, through attendance at symposia, conferences, and meetings, to ensure effective and, ultimately, efficient, program management and oversight by site visits to projects supported by the Foundation.

TRAVEL

(Thousands of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Estimate	Change Amount	Change Percent
Biological Sciences	226	295	350	55	18.6%
Budget, Finance and Awards Management	45	50	50	0	0.0%
Computer and Information, Science and Engineering	173	230	273	43	18.7%
Education and Human Resources	242	320	380	60	18.8%
Engineering	331	430	510	80	18.6%
Geosciences	289	380	452	72	18.9%
Information and Resources Management	36	40	40	0	0.0%
Mathematics and Physical Sciences	292	450	534	84	18.7%
Social, Behavorial and Economic Sciences	217	285	338	53	18.6%
Staff Offices of the Director	480	520	563	43	8.3%
TOTAL TRAVEL	$2,331	$3,000	$3,490	$490	16.3%

General Operating Expenses

General Operating Expenses (GOE) constitutes the remainder of the Salaries and Expenses appropriation and funds the entire range of operating expenses necessary for the Foundation to administer its programs. The FY 1995 request for General Operating Expenses, including travel costs discussed separately in the preceding narrative, is $43.05 million, an increase of $5.50 million over the FY 1994 level of $37.55 million. The primary cost categories for General Operating Expenses are:

- **Physical Infrastructure**, which includes space rental charges on the new NSF Headquarters in Arlington, Virginia, as well as costs for telecommunications infrastructure, including telephone, telegraph, and postage.
- **Information Infrastructure**, which continues the Foundation's investment in information technology and includes ADP operations and maintenance, software development, and data processing equipment and supplies.
- **Other General Operating Expenses**, which includes printing and reproduction, administrative contracts, employee training, and office supplies and materials.

Physical Infrastructure costs, budgeted at $20.5 million in FY 1995, increase $ 0.80 million over the FY 1994 level. These costs include charges by the General Services Administration (GSA) for the Foundation's new state-of-the-art Headquarters location in Arlington, Virginia. Office space rentals comprise more than 80% of these costs.

Information Infrastructure costs, budgeted at $11.59 million in FY 1995, increase $3.22 million over the FY 1994 level. This request continues the Foundation's major investment in new technology to improve business operations and to respond to significant workload increases. NSF's information infrastructure is characterized by distributed multi-functional workstations that support a wide range of automated administrative and programmatic work processes, including electronic mail, electronic timekeeping and record-keeping systems, and powerful computational capabilities.

Specific information technology investments targeted for FY 1995 include enhanced customer support for new technologies and systems; infrastructure improvements to support activities such as video conferencing, telecommuting, imaging, and high-speed data communications; the upgrade of the Foundation's microcomputer inventory; and, the acceleration of the move toward a distributed environment which allows more processing to be done at individual workstations rather than on the mainframe.

Other General Operating Expenses, budgeted at $7.47 million in FY 1995, increase $0.99 million over the FY 1994 level. These costs include administrative contracts for warehousing, mail handling, addressing services, equipment repair and maintenance. The cost increases include administrative contracts associated with additional security requirements at the new location and the operation of the NSF health unit, and automation of the Foundation's library facilities.

The following chart specifies these increases by Object Class and is followed by detailed explanations of each Object Class increase:

GENERAL OPERATING EXPENSES
(Including Travel)

(Thousands of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Estimate	Change Amount	Change Percent
Travel	2,331	3,000	3,490	490	16.3%
Transportation of Things	204	210	210	0	0.0%
Rents and Communications:					
Office Space Rentals	9,118	16,400	17,100	700	4.3%
Data Processing Equipment and other Rentals	444	450	450	0	0.0%
Telephone, Telegraph and Postage	3,294	3,300	3,400	100	3.0%
Subtotal, Rents and Communications	12,856	20,150	20,950	800	4.0%
Printing and Reproduction	485	500	578	78	15.6%
Consulting Services	260	260	260	0	0.0%
Other Contractual Services:					
Administrative Contracts	3,100	2,987	3,513	526	17.6%
DP Operations & Maint.	4,141	2,587	4,350	1,763	68.1%
DP Software Development	2,783	2,700	3,150	450	16.7%
Employment Training	528	550	700	150	27.3%
Subtotal, Other Contr. Serivces	10,552	8,824	11,713	2,889	32.7%
Purchases of goods and services from Government accounts	383	300	300	0	0.0%
Supplies and Materials:					
Office and Printing	787	780	910	130	16.7%
Data Processing	109	120	120	0	0.0%
Subtotal, Supplies and Materials	896	900	1,030	130	14.4%
Equipment:					
Admin. Services Equipment	540	439	539	100	22.8%
Data Processing Equipment	2,847	2,961	3,971	1,010	34.1%
Subtotal, Equipment	3,387	3,400	4,510	1,110	32.6%
Reception and Representation	6	6	9	3	50.0%
TOTAL, Other Expenses	$31,360	$37,550	$43,050	$5,500	14.6%

- **Transportation of Things** consists of contracts for labor support to move furniture, equipment and other items. There is no FY 1995 increase.

- **Office Space Rentals** increase by $700,000. Office space rentals include the rent charged by GSA for NSF's new facility in Arlington, Virginia. NSF consolidated four downtown office locations into a new headquarters building in early FY 1994. The Arlington facility includes a state-of-the-art telecommunications infrastructure, an enhanced conference and training center, and a modern, open-office work environment. The increase of $700,000 reflects the rental increase projected by GSA.

- **Equipment Rentals** costs, which do not increase in FY 1995, include the cost of rental, maintenance and page charges for NSF copiers located in copier stations on each floor of the new building as well as in the Foundation print plant, the library and other service areas of the agency.

- **Postage Costs** increase by $100,000. These costs include all costs for metered mail, in support of the agency's proposal review process, and bulk mail charges for distribution of agency publications. The increase of $100,000 reflects an anticipated postal rate increase as well as an increase in usage in FY 1995.

- **Printing and Reproduction** includes contract costs of composition and printing of NSF publications, announcements and forms, and printing of stationery and specialty items. The increase of $78,000 reflects increases in contract costs and in volume, as well as the cost of new publications.

- **Administrative Contracts** include warehousing and supply services, mail handling, addressing services, equipment repair and maintenance, carpet installation and repair, renovation costs, furniture repair, and miscellaneous small contracts. The increase of $0.52 million includes cost increases due to inflation and the cost of additional services (e.g., security) associated with the new building ($0.39); and an increase ($0.06 million) in the cost of health contracts for the operation of the NSF Health Unit. As a result of the Foundation move to a new building, NSF is no longer able to share the cost of the Health Unit with the United States Secret Service. Lastly, there is a small increase ($0.07 million) for conversion of NSF library resources to CDROM technology to provide greater and more efficient access to information resources.

- **ADP Operations/Maintenance** includes management and operation of the central computer facility; operation of the customer service center; maintenance of mainframe hardware; software licensing fees; data communications infrastructure and systems support; central systems support, remote access (e.g., Internet); and staff training on new systems.

  ADP Operations and Maintenance will increase by $1.76 million over the amounts budgeted with FY 1994 funds; $1.21 million in available FY 1993 funding was applied to FY 1994 requirements for central facility management and operation and the customer service center for a net increase in FY 1995 over FY 1994 of $550,000. Of the net increase of $550,000, $200,000 is requested to cover contractually stipulated annual increases for maintenance and operational contracts. An additional $350,000 will allow NSF to expand the services being provided by its Customer Service Center in order to respond to requirements for training, assistance, and documentation related to the growth of new technologies and systems. New assistance will also be required for internet and other electronic communications usage.

- **ADP Software Development** increases by $450,000. In FY 1994 NSF will experiment with new "down-sized" technologies which will operate locally on personal computers and complement centralized operations in the mainframe environment. Pilot projects will be initiated with the goal of working smarter with less by utilizing state-of-the-art information systems. In FY 95 many of the pilots will be implemented throughout the Agency For example, the Foundation will aggressively pursue a goal of eliminating paper processing. Proposals will be scanned and electronically filed as will paper created by reviews, recommendations, etc. Electronic forms for memoranda, correspondence, service requests and personnel actions will be created. NSF will also expand on experiments related to the concept of an electronically supported "virtual workplace" where an employee, regardless of location, will have access to resources such as mail, phone, conferencing, library, and proposal jackets.

- **Training Contracts** increase by $150,000. This increase includes a major new initiative, targeted curriculum, and additional centralized funding of training courses for all staff. The targeted curriculum initiative includes the leadership development program, which will impact all supervisors, managers and executives, and the support staff development program.

- **Supplies and Materials** include print plant paper, copier paper, printing supplies, office and miscellaneous supplies. This increase of $130,000 is due to normal increases in usage and in the costs of paper products.

- **Data Processing Equipment** increases by $1.01 million. The amount requested will allow NSF to purchase the hardware and software necessary to sustain quality operations at the authorized staffing levels. This will be done partially by pilot projects in advanced automation and work processing. The transition from pilot status to full implementation in FY 1995 will require a significant investment in hardware and software in support of activities such as video conferencing, telecommuting, imaging, new high speed fiber cabling, and e-mail/voice linkages. This request also includes funding to upgrade NSF's aging microcomputer inventory. The purchase of advanced microcomputers will enable the Foundation to accelerate the move toward a client-server environment, thereby allowing more processing to be done at the individual workstations rather than on the mainframe. In addition, NSF staff will be able to take full advantage of the benefits of new systems and applications as they become available.

- **Reception and Representation Expenses** are budgeted at $9,000. Of this amount, $2,500 had been previously available in the Polar Programs appropriation in FY 1994 and prior, but is combined with the Salaries and Expenses appropriation for FY 1995.

PERSONNEL SUMMARY

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Change Amount	Change Percent
Total Compensable Workyears	1,202	1,208	1,248	40	3.3%
Full-Time Equivalent Employment	1,197	1,203	1,243	40	3.3%
FTE overtime and Holiday Hours	5	5	5	0	0.0%
Average GS Grade	9.62	9.62	9.63	0	0.1%
Average Salary	$54,150	$54,450	$57,390	$2,940	5.4%

DETAIL OF PERMANENT POSITIONS

	FY 1993 Actual	FY 1994 Estimate	FY 1995 Estimate
Executive Level II	0	1	1
Executive Level III	1	1	1
Subtotal	**1**	**2**	**2**
ES-6	14	14	14
ES-5	16	16	16
ES-4	48	51	48
ES-3	4	7	10
ES-2	5	15	15
ES-1	9	14	14
Subtotal	**96**	**117**	**117**
AD	**220**	**204**	**230**
GS/GM-15	80	80	78
GS/GM-14	80	80	78
GS/GM-13	66	66	66
GS-12	75	75	81
GS-11	59	59	65
GS-10	8	8	8
GS-9	62	62	62
GS-8	74	74	74
GS-7	84	84	84
GS-6	130	130	130
GS-5	59	59	59
GS-4	22	22	22
GS-3	3	3	3
Subtotal	**802**	**802**	**810**
UNGRADED	**1**	**1**	**1**
TOTAL PERMANENT APPOINTMENTS	1,120	1,126	1,160
FTE CEILING	1,197	1,203	1,243

NSF HEADQUARTERS RELOCATION $5,200,000

The FY 1995 Budget Request for Headquarters Relocation is $5.20 million. This appropriation account provides annual reimbursement to the General Services Administration (GSA) through FY 1998 for expenses incurred by GSA pursuant to the relocation of the National Science Foundation to Arlington, Virginia, which was completed in January, 1994.

(Millions of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Change Amount	Change Percent
NSF Headquarters Relocation	$0.00	$5.20	$5.20	$0.00	0.0%

In January 1993, the National Science Foundation, the General Services Administration (GSA) and OMB entered into an interagency agreement regarding the NSF relocation to Arlington, Virginia. As part of the agreement, GSA agreed to provide funding in FY 1993 for relocation expenses; and for all rent costs in the new NSF building during FY 1993. NSF agreed to request funds to make annual reimbursements to GSA in five installments beginning in FY 1994 and continuing through FY 1998.

The FY 1995 request of $5.20 million for reimbursement to GSA includes the second of five installments to GSA for relocation expenses provided in FY 1992 ($0.40 million), the cost of the actual relocation in FY 1993 ($1.80 million), and the FY 1993 rent on the new building ($1.20 million). Additionally, the FY 1995 request includes installment payments for 1,500 systems furniture workstations ($1.50 million) and a telephone system for the new building ($0.30 million).

OFFICE OF INSPECTOR GENERAL $4,380,000

The FY 1995 request for the Office of Inspector General (OIG) Activity is $4.38 million, an overall increase of $383,000 or approximately 9.5 percent over the FY 1994 Current Plan of $3.997 million.

(Millions of Dollars)

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request	Change Amount	Change Percent
Personnel Compensation & Benefits	2.47	2.73	3.05	0.32	11.7%
Other Operating Expenses	1.22	1.27	1.33	0.06	4.7%
TOTAL	$3.69	$4.00	$4.38	0.38	9.5%
Full-Time Equivalent Employment	38	42	46		

In February 1989, the National Science Board established the Office of Inspector General for NSF pursuant to the Inspector General Act Amendments of 1988. The statute confers on the Office of Inspector General the responsibility and the authority to:

- Conduct and supervise audits of NSF programs and operations, including organizations that receive NSF funding.
- Conduct investigations concerning NSF programs and operations, including organizations that receive NSF funding.
- Evaluate allegations of misconduct in science and engineering, such as fabrication or falsification of data and plagiarism, involving scientists that request or receive NSF funding.
- Provide leadership and coordination and recommend policies for activities designed to:
  - (a) promote economy, efficiency, and effectiveness in the administration of NSF programs and operations, and
  - (b) prevent and detect fraud and abuse in NSF programs and operations.
- Issue Semiannual Reports to keep the National Science Board and Congress fully and currently informed about problems and deficiencies relating to the administration of NSF programs and operations and the necessity for and progress of corrective action.

The OIG is comprised of three operational organizations: Audit, Investigations, and Oversight. The Office of Audit is responsible for external audits of NSF grants and contracts at universities and commercial and nonprofit organizations that receive NSF funding. Internal audits are also conducted within NSF to evaluate financial and administrative aspects of NSF activities; to evaluate data processing systems employed by NSF; and to assess the adequacy of internal controls. The Office of Audit ensures that management implements recommendations included in all reports issued by OIG and the General Accounting Office. The Office of Audit is also responsible for pre-award audits and for recommending to NSF's Division of Contracts, Policy and Oversight the final indirect cost rates applicable to NSF awards.

The Investigations Unit is responsible for investigating charges of criminal and administrative violations by NSF staff and funded organizations.

The Office of Oversight is responsible for evaluating allegations of misconduct in science and engineering, such as fabrication or falsification of data and plagiarism. The Oversight Office also manages OIG's inspection program; reviews and evaluates the processing of proposals for funding from NSF; monitors procedures used to ensure external peer oversight of NSF programs; and monitors adherence to NSF conflict-of-interest regulations as they apply to new and former staff.

An increase of $383,000 over the FY 1994 Current Plan is requested for the Office of Inspector General in FY 1995.

	FY 1993 Actual	FY 1994 Current Plan	FY 1995 Request
Personnel Compensation & Benefits	2,470,000	2,732,000	3,050,000
Travel and Transportation of Persons	84,000	110,000	110,000
Rental Payments to GSA	0	0	0
Communications, Utilities and Miscellaneous Charges	6,000	6,000	6,000
Printing and Reproduction	0	0	0
Other Services	1,080,000	1,070,000	1,150,000
Supplies and Materials	16,000	29,000	29,000
Equipment	31,000	50,000	35,000
TOTAL	$3,687,000	$3,997,000	$4,380,000

During its first years of operation, the Office of Inspector General addressed the requirements of the Inspector General Act with the addition of experienced personnel in the legal, scientific, and criminal investigation disciplines. Additional personnel were needed to address concerns in the areas of misconduct in science and engineering, conflict-of-interest, and allegations of criminal activity. There were also adjustments within the office necessary to meet the additional demands of the Inspector General Act amendments. These include production of semiannual reports to Congress, establishment of working relationships with the National Science Board (the statutory supervisor of the Office of Inspector General), attainment of professional standards imposed on the disciplines represented in the office, and redefinition of day-to-day working relationships with NSF.

In response to recommendations from the Senate Committee on Governmental Affairs, OIG is now increasing, over a period of years as resources become available, the number of audits that are conducted at organizations that receive NSF funding. Additional audit resources are also needed to supplement the OIG's inspection program and to cover the substantial increased audit responsibilities under the Chief Financial Officers Act of 1990. The OIG also requests additional resources in order to effectively manage allegations of financial fraud and misconduct in science.

Since the Department of Veteran Affairs, and Housing and Urban Development, and Independent Agencies Appropriations Act provides for a separate appropriation for NSF's Office of Inspector General, the 1995 Request separately identifies the resources needed to support the Office of Inspector General. These resources include amounts for personnel compensation and benefits; contract audits; operational travel; and office supplies, materials, and equipment.

Personnel compensation and benefits costs will increase by $318,000 or 11.7 percent over the 1994 Plan. The increase requested for salaries and benefits reflects the costs to support 46 FTEs, an increase of 4 FTEs over the FY 1994 level. The 4 FTEs will be used to employ staff at the entry level. This new entry-level staff will help OIG economically and effectively manage increased audit responsibilities and increased needs in handling allegations of financial fraud and misconduct in science. The increased funding will also cover cost of living and other routine costs associated with current staffing. Along with the hiring of additional entry-level staff, contracts with C.P.A. firms for external audits will increase by $80,000 to $1.13 million, to compensate for the increase in contract costs and to improve the audit cycle. Consistent with the tight budget environment, travel will remain constant at $110,000. In addition, equipment expenses will be reduced by $15,000.

The table showing the detail of permanent positions is a summary of Permanent Positions as of the end of FY 1993 and estimated to be filled at the end of FY 1994 and FY 1995.

DETAIL OF PERMANENT POSITIONS

Grade	FY 1993 Actual	FY 1994 Estimate	FY 1995 Estimate
ES	3	4	4
Subtotal	**3**	**4**	**4**
AD	6	6	6
Subtotal	**6**	**6**	**6**
GS/GM - 15	1	0	0
GS/GM - 14	6	7	7
GS/GM - 13	6	6	5
GS - 12	2	2	3
GS - 11	5	6	6
GS - 10	0	0	0
GS - 9	4	5	5
GS - 8	2	2	2
GS - 7	3	2	5
GS - 6	1	1	1
GS - 5	0	1	2
GS - 4	0	0	0
Subtotal	**30**	**32**	**36**
TOTAL PERMANENT POSITIONS	**39**	**42**	**46**

NATIONAL SCIENCE FOUNDATION

Research and Development Special Analysis

	Actual FY 1993	Estimate FY 1994	Estimate FY 1995
Support of R&D		Dollars in Thousands	
Conduct of Research			
Basic Research	$1,743,770	$1,877,964	$2,043,793
Applied Research	138,119	157,914	175,246
Development	0	0	0
Subtotal, Conduct of R&D	1,881,889	2,035,878	2,219,039
(Cooduct of R&D Performed by Colleges and Universities.)	(1,561,930)	(1,678,326)	(1,816,331)
R&D Facilities			
Land, Building and Fixed Equipment	46,389	58,283	33,869
Major Equipment	84,047	146,035	135,290
Subtotal, R&D Facilities & Major Equipment	130,436	204,318	169,159
Total, Support of R&D	2,012,325	2,240,196	2,388,198
Non-Investment Activities*	329,791	317,637	336,371
Education and Training	407,610	459,964	475,431
TOTAL	$2,749,726	$3,017,797	$3,200,000

Quantitative Data Table

	Actual FY 1993	Estimate FY 1994	Estimate FY 1995
Proposal Summary		Dollars in Thousands	
Number of Proposals Received	61,214	62,946	67,066
Dollars Requested (Total)	$13,508,760	$14,167,454	$15,260,807
Action Summary			
Number of Awards	18,216	19,097	19,525
Dollars Obligated (Total)	2,749,726	3,017,797	3,200,000
Dollar Distribution by Performer			
Universities	1,882,129	2,090,257	2,198,363
Industry	162,387	204,279	221,937
Federal Agencies	148,610	103,217	105,612
Other	556,600	620,044	674,088
Subtotal, Dollar Distribution by Performer	2,749,726	3,017,797	3,200,000
Personnel			
Senior Scientists			
Number of Scientists Supported	23,038	24,784	25,775
Amount of Scientist Support	275,943	301,779	325,962
Number of Years of Scientist Support	5,701	6,060	6,427
Postdoctoral Support			
Number of Postdoctorals Supported	4,281	4,519	4,855
Amount of Postdoctoral Support	84,981	89,657	97,578
Graduate Students			
Number of Graduate Students Supported	19,558	20,684	21,350
Amount of Graduate Student Support	275,030	269,928	288,672
Other Personnel Costs			
Amount of Support	228,717	256,721	275,071
R&D Facilities, Equipment and Instrumentation			
Land, Buildings and Fixed Equipment	46,389	58,283	33,869
Major Equipment	84,047	146,035	135,290
Other Equipment and Instrumentation	156,705	174,284	188,703
Subtotal, R&D Fac., Equip. and Instrumentation	287,141	378,602	357,862
Other Direct Research Costs**	807,579	903,076	971,753
Indirect Costs	460,544	500,397	546,731
Non-Investment Activities	329,791	317,637	336,371
TOTAL	$2,749,726	$3,017,797	$3,200,000

*Includes "Collection of Information."

**Includes: Supplies, Publications, Consultants, Computer Services, Subcontracts, Travel, and Fringe Benefits.

RESEARCH AND RELATED ACTIVITIES

Research and Development Special Analysis

	Actual FY 1993	Estimate FY 1994	Estimate FY 1995
Support of R&D		Dollars in Thousands	
Conduct of Research			
Basic Research	$1,682,452	$1,809,084	$1,975,830
Applied Research	108,421	127,198	143,980
Development	0	0	0
Subtotal, Conduct of R&D	1,790,873	1,936,282	2,119,810
(Conduct of R&D Performed by Colleges and Universities.).	(1,483,355)	(1,591,527)	(1,729,498)
R&D Facilities			
Land, Building and Fixed Equipment	9,107	8,283	6,369
Major Equipment	71,575	96,035	37,790
Subtotal, R&D Facilities & Major Equipment	80,682	104,318	44,159
Total, Support of R&D	1,871,555	2,040,600	2,163,969
Non-Investment Activities*	208,829	180,100	184,731
Education and Training	0	0	0
TOTAL	$2,080,384	$2,220,700	$2,348,700

Quantitative Data Table

	Actual FY 1993	Estimate FY 1994	Estimate FY 1995
Proposal Summary		Dollars in Thousands	
Number of Proposals Received	41,890	44,672	48,219
Dollars Requested (Total)	9,987,103	10,825,454	11,777,707
Action Summary			
Number of Awards	15,895	16,324	16,750
Dollars Obligated (Total)	2,080,384	2,220,700	2,348,700
Dollar Distribution by Performer			
Universities	1,509,031	1,635,487	1,730,498
Industry	129,069	164,159	180,962
Federal Agencies	142,926	97,117	99,312
Other	299,358	323,937	337,928
Subtotal, Dollar Distribution by Performer	2,080,384	2,220,700	2,348,700
Personnel			
Senior Scientists			
Number of Scientists Supported	18,489	19,459	20,355
Amount of Scientist Support	221,792	238,772	261,662
Number of Years of Scientist Support	4,575	4,863	5,222
Postdoctoral Support			
Number of Postdoctorals Supported	4,001	4,182	4,514
Amount of Postdoctoral Support	80,590	84,635	92,480
Graduate Students			
Number of Graduate Students Supported	15,486	16,216	16,787
Amount of Graduate Student Support	191,872	203,848	218,482
Other Personnel Costs			
Amount of Support	191,694	209,821	227,721
R&D Facilities, Equipment and Instrumentation			
Land, Buildings and Fixed Equipment	9,107	8,283	6,369
Major Equipment	71,575	96,035	37,790
Other Equipment and Instrumentation	127,727	141,254	154,868
Subtotal, R&D Fac., Equip. and Instrumentation	208,409	245,572	199,027
Other Direct Research Costs**	571,063	619,435	680,618
Indirect Costs	406,135	438,517	483,979
Non-Investment Activities	208,829	180,100	184,731
TOTAL	$2,080,384	$2,220,700	$2,348,700

*Includes "Collection of Information."

**Includes Supplies, Publications, Consultants, Computer Services, Subcontracts, Travel, and Fringe Benefits.

BIOLOGICAL SCIENCES

Research and Development Special Analysis

	Actual FY 1993	Estimate FY 1994	Estimate FY 1995
		Dollars in Thousands	
Support of R&D			
Conduct of Research			
Basic Research	$262,789	$279,710	$304,840
Applied Research	8,535	9,070	9,100
Development	0	0	0
Subtotal, Conduct of R&D	271,324	288,780	313,940
(Conduct of R&D Performed by Colleges and Universities.)	(244,100)	(258,900)	(282,400)
R&D Facilities			
Land, Building and Fixed Equipment	0	0	0
Major Equipment	0	0	0
Subtotal, R&D Facilities & Major Equipment	0	0	0
Total, Support of R&D	271,324	288,780	313,940
Non-Investment Activities*	0	0	0
Education and Training	0	0	0
TOTAL	$271,324	$288,780	$313,940

Quantitative Data Table

	Actual FY 1993	Estimate FY 1994	Estimate FY 1995
		Dollars in Thousands	
Proposal Summary			
Number of Proposals Received	7,833	8,274	9,011
Dollars Requested (Total)	1,936,660	2,043,300	2,220,200
Action Summary			
Number of Awards	2,897	2,899	2,901
Dollars Obligated (Total)	271,324	288,780	313,940
Dollar Distribution by Performer			
Universities	244,100	258,900	282,400
Industry	2,300	2,420	2,620
Federal Agencies	836	890	990
Other	24,088	26,570	27,930
Subtotal, Dollar Distribution by Performer	271,324	288,780	313,940
Personnel			
Senior Scientists			
Number of Scientists Supported	2,041	2,090	2,205
Amount of Scientist Support	24,691	26,080	28,460
Number of Years of Scientist Support	927	960	1,015
Postdoctoral Support			
Number of Postdoctorals Supported	992	1,010	1,070
Amount of Postdoctoral Support	22,019	23,200	25,160
Graduate Students			
Number of Graduate Students Supported	1,852	1,897	1,995
Amount of Graduate Student Support	21,791	23,030	25,070
Other Personnel Costs			
Amount of Support	29,526	31,310	34,240
R&D Facilities, Equipment and Instrumentation			
Land, Buildings and Fixed Equipment	0	0	0
Major Equipment	0	0	0
Other Equipment and Instrumentation	23,852	25,800	28,240
Subtotal, R&D Fac., Equip. and Instrumentation	23,852	25,800	28,240
Other Direct Research Costs**	81,909	88,040	95,120
Indirect Costs	67,536	71,320	77,650
Non-Investment Activities	0	0	0
TOTAL	$271,324	$288,780	$313,940

*Includes "Collection of Information."

**Includes: Supplies, Publications, Consultants, Computer Services, Subcontracts, Travel, and Fringe Benefits.

COMPUTER & INFORMATION SCIENCE & ENGINEERING

Research and Development Special Analysis

	Actual FY 1993	Estimate FY 1994	Estimate FY 1995
Support of R&D		Dollars in Thousands	
Conduct of Research			
Basic Research	180,886	203,969	231,809
Applied Research	6,954	8,376	9,571
Development	0	0	0
Subtotal, Conduct of R&D	187,840	212,345	241,380
(Conduct of R&D Performed by Colleges and Universities.)	(157,738)	(174,043)	(197,932)
R&D Facilities			
Land, Building and Fixed Equipment	2,700	1,735	1,974
Major Equipment	25,063	26,500	30,146
Subtotal, R&D Facilities & Major Equipment	27,763	28,235	32,120
Total, Support of R&D	215,603	240,580	273,500
Non-Investment Activities*	0	0	0
Education and Training	0	0	0
TOTAL	$215,603	$240,580	$273,500

Quantitative Data Table

	Actual FY 1993	Estimate FY 1994	Estimate FY 1995
Proposal Summary		Dollars in Thousands	
Number of Proposals Received	3,552	3,962	4,512
Dollars Requested (Total)	1,349,298	1,546,059	1,764,443
Action Summary			
Number of Awards	1,394	1,523	1,720
Dollars Obligated (Total)	215,603	240,580	273,500
Dollar Distribution by Performer			
Universities	157,738	174,043	197,932
Industry	19,620	21,532	24,700
Federal Agencies	596	758	857
Other	37,649	44,247	50,011
Subtotal, Dollar Distribution by Performer	215,603	240,580	273,500
Personnel			
Senior Scientists			
Number of Scientists Supported	1,389	1,548	1,764
Amount of Scientist Support	19,880	22,198	25,281
Number of Years of Scientist Support	303	339	386
Postdoctoral Support			
Number of Postdoctorals Supported	244	262	294
Amount of Postdoctoral Support	3,770	3,929	4,462
Graduate Students			
Number of Graduate Students Supported	1,536	1,698	1,939
Amount of Graduate Student Support	24,049	26,678	30,468
Other Personnel Costs			
Amount of Support	21,317	23,115	26,197
R&D Facilities, Equipment and Instrumentation			
Land, Buildings and Fixed Equipment	2,700	1,735	1,974
Major Equipment	25,063	26,500	30,146
Other Equipment and Instrumentation	10,039	11,635	13,222
Subtotal, R&D Fac., Equip. and Instrumentation	37,802	39,870	45,342
Other Direct Research Costs**	64,444	76,113	86,393
Indirect Costs	44,341	48,677	55,357
Non-Investment Activities	0	0	0
TOTAL	$215,603	$240,580	$273,500

*Includes "Collection of Information."

**Includes Supplies, Publications, Consultants, Computer Services, Subcontracts, Travel, and Fringe Benefits.

ENGINEERING

Research and Development Special Analysis

	Actual FY 1993	Estimate FY 1994	Estimate FY 1995
		Dollars in Thousands	
Support of R&D			
Conduct of Research			
Basic Research	$186,904	$211,550	$224,410
Applied Research	69,150	83,620	96,000
Development	0	0	0
Subtotal, Conduct of R&D	256,054	295,170	320,410
(Conduct of R&D Performed by Colleges and Universities.)	(221,430)	(244,700)	(257,220)
R&D Facilities			
Land, Building and Fixed Equipment	0	0	0
Major Equipment	0	0	0
Subtotal, R&D Facilities & Major Equipment	0	0	0
Total, Support of R&D	256,054	295,170	320,410
Non-Investment Activities*	0	0	0
Education and Training	0	0	0
TOTAL	$256,054	$295,170	$320,410

Quantitative Data Table

	Actual FY 1993	Estimate FY 1994	Estimate FY 1995
		Dollars in Thousands	
Proposal Summary			
Number of Proposals Received	9,227	10,000	10,500
Dollars Requested (Total)	$1,809,669	$2,000,000	$2,100,000
Action Summary			
Number of Awards	2,716	2,890	3,020
Dollars Obligated (Total)	256,054	295,170	320,410
Dollar Distribution by Performer			
Universities	221,430	244,700	257,220
Industry	28,433	43,500	55,890
Federal Agencies	275	300	300
Other	5,916	6,670	7,000
Subtotal, Dollar Distribution by Performer	256,054	295,170	320,410
Personnel			
Senior Scientists			
Number of Scientists Supported	3,702	4,320	4,820
Amount of Scientist Support	38,848	45,150	50,600
Number of Years of Scientist Support	873	1,015	1,135
Postdoctoral Support			
Number of Postdoctorals Supported	319	355	365
Amount of Postdoctoral Support	5,141	5,650	5,910
Graduate Students			
Number of Graduate Students Supported	3,559	3,950	4,140
Amount of Graduate Student Support	47,558	53,100	55,600
Other Personnel Costs			
Amount of Support	28,616	38,150	41,200
R&D Facilities, Equipment and Instrumentation			
Land, Buildings and Fixed Equipment	0	0	0
Major Equipment	0	0	0
Other Equipment and Instrumentation	16,251	19,400	21,100
Subtotal, R&D Fac., Equip. and Instrumentation	16,251	19,400	21,100
Other Direct Research Costs**	58,249	62,250	67,000
Indirect Costs	61,391	71,470	79,000
Non-Investment Activities	0	0	0
TOTAL	$256,054	$295,170	$320,410

*Includes "Collection of Information."

**Includes: Supplies, Publications, Consultants, Computer Services, Subcontracts, Travel, and Fringe Benefits.

GEOSCIENCES

Research and Development Special Analysis

	Actual FY 1993	Estimate FY 1994	Estimate FY 1995
Support of R&D		Dollars in Thousands	
Conduct of Research			
Basic Research	$370,615	$392,242	$430,332
Applied Research	2,858	3,025	3,319
Development	0	0	0
Subtotal, Conduct of R&D	373,473	395,267	433,651
(Conduct of R&D Performed by Colleges and Universities.)	(255,258)	(270,153)	(296,388)
R&D Facilities			
Land, Building and Fixed Equipment	2,407	2,548	2,795
Major Equipment	5,722	6,055	6,644
Subtotal, R&D Facilities & Major Equipment	8,129	8,603	9,439
Total, Support of R&D	381,602	403,870	443,090
Non-Investment Activities*	0	0	0
Education and Training	0	0	0
TOTAL	$381,602	$403,870	$443,090

Quantitative Data Table

	Actual FY 1993	Estimate FY 1994	Estimate FY 1995
Proposal Summary		Dollars in Thousands	
Number of Proposals Received	6,096	6,452	7,078
Dollars Requested (Total)	$1,552,413	$1,643,002	$1,802,554
Action Summary			
Number of Awards	2,486	2,520	2,520
Dollars Obligated (Total)	381,602	403,870	443,090
Dollar Distribution by Performer			
Universities	255,258	270,153	296,388
Industry	2,818	2,983	3,272
Federal Agencies	6,060	6,414	7,036
Other	117,466	124,320	136,394
Subtotal, Dollar Distribution by Performer	381,602	403,870	443,090
Personnel			
Senior Scientists			
Number of Scientists Supported	3,972	4,005	4,005
Amount of Scientist Support	43,830	46,388	50,893
Number of Years of Scientist Support	744	787	864
Postdoctoral Support			
Number of Postdoctorals Supported	464	490	520
Amount of Postdoctoral Support	6,965	7,371	8,087
Graduate Students			
Number of Graduate Students Supported	1,779	1,780	1,780
Amount of Graduate Student Support	21,993	23,276	25,536
Other Personnel Costs			
Amount of Support	47,937	50,734	55,661
R&D Facilities, Equipment and Instrumentation			
Land, Buildings and Fixed Equipment	2,407	2,548	2,795
Major Equipment	5,722	6,055	6,644
Other Equipment and Instrumentation	17,060	18,056	19,808
Subtotal, R&D Fac., Equip. and Instrumentation	25,189	26,659	29,247
Other Direct Research Costs**	164,585	174,190	191,106
Indirect Costs	71,103	75,252	82,560
Non-Investment Activities	0	0	0
TOTAL	$381,602	$403,870	$443,090

*Includes "Collection of Information."

**Includes Supplies, Publications, Consultants, Computer Services, Subcontracts, Travel, and Fringe Benefits

MATHEMATICAL AND PHYSICAL SCIENCES

Research and Development Special Analysis

	Actual FY 1993	Estimate FY 1994	Estimate FY 1995
Support of R&D		Dollars in Thousands	
Conduct of Research			
Basic Research	$565,086	$595,270	$642,930
Applied Research	11,050	12,100	13,190
Development	0	0	0
Subtotal, Conduct of R&D	576,136	607,370	656,120
(Conduct of R&D Performed by Colleges and Universities.)	(493,140)	(520,490)	(557,420)
R&D Facilities			
Land, Building and Fixed Equipment	3,000	1,000	600
Major Equipment	6,720	11,480	1,000
Subtotal, R&D Facilities & Major Equipment	9,720	12,480	1,600
Total, Support of R&D	585,856	619,850	657,720
Non-Investment Activities*	0	0	0
Education and Training	0	0	0
TOTAL	$585,856	$619,850	$657,720

Quantitative Data Table

	Actual FY 1993	Estimate FY 1994	Estimate FY 1995
Proposal Summary		Dollars in Thousands	
Number of Proposals Received	9,953	10,551	11,419
Dollars Requested (Total)	$2,275,676	$2,403,397	$2,639,914
Action Summary			
Number of Awards	4,406	4,453	4,450
Dollars Obligated (Total)	585,856	619,850	657,720
Dollar Distribution by Performer			
Universities	498,816	529,450	558,420
Industry	1,350	1,420	1,530
Federal Agencies	1,610	1,660	1,870
Other	84,080	87,320	95,900
Subtotal, Dollar Distribution by Performer	585,856	619,850	657,720
Personnel			
Senior Scientists			
Number of Scientists Supported	5,668	5,726	5,725
Amount of Scientist Support	72,840	75,690	80,500
Number of Years of Scientist Support	1,266	1,283	1,319
Postdoctoral Support			
Number of Postdoctorals Supported	1,782	1,854	2,039
Amount of Postdoctoral Support	39,640	41,240	45,350
Graduate Students			
Number of Graduate Students Supported	5,631	5,698	5,700
Amount of Graduate Student Support	65,960	66,460	69,150
Other Personnel Costs			
Amount of Support	56,480	58,250	61,600
R&D Facilities, Equipment and Instrumentation			
Land, Buildings and Fixed Equipment	3,000	1,000	600
Major Equipment	6,720	11,480	1,000
Other Equipment and Instrumentation	54,460	59,650	65,070
Subtotal, R&D Fac., Equip. and Instrumentation	64,180	72,130	66,670
Other Direct Research Costs**	156,620	168,890	184,040
Indirect Costs	130,136	137,190	150,410
Non-Investment Activities	0	0	0
TOTAL	$585,856	$619,850	$657,720

*Includes "Collection of Information."

**Includes: Supplies, Publications, Consultants, Computer Services, Subcontracts, Travel, and Fringe Benefits.

SOCIAL, BEHAVIORAL & ECONOMIC SCIENCES

Research and Development Special Analysis

	Actual FY 1993	Estimate FY 1994	Estimate FY 1995
		Dollars in Thousands	
Support of R&D			
Conduct of Research			
Basic Research	$67,499	$72,863	$83,316
Applied Research	9,715	10,807	12,583
Development	0	0	0
Subtotal, Conduct of R&D	77,214	83,670	95,899
(Conduct of R&D Performed by Colleges and Universities.)	(64,143)	(69,561)	(79,728)
R&D Facilities			
Land, Building and Fixed Equipment	0	0	0
Major Equipment	0	0	0
Subtotal, R&D Facilities & Major Equipment	0	0	0
Total, Support of R&D	77,214	83,670	95,899
Non-Investment Activities*	13,455	14,580	16,711
Education and Training	0	0	0
TOTAL	$90,669	$98,250	$112,610

Quantitative Data Table

	Actual FY 1993	Estimate FY 1994	Estimate FY 1995
		Dollars in Thousands	
Proposal Summary			
Number of Proposals Received	4,393	4,500	4,700
Dollars Requested (Total)	$555,698	$612,000	$686,000
Action Summary			
Number of Awards	1,578	1,600	1,680
Dollars Obligated (Total)	90,669	98,250	112,610
Dollar Distribution by Performer			
Universities	64,143	69,561	79,728
Industry	4,083	4,421	5,067
Federal Agencies	7,354	7,958	9,122
Other	15,089	16,310	18,693
Subtotal, Dollar Distribution by Performer	90,669	98,250	112,610
Personnel			
Senior Scientists			
Number of Scientists Supported	1,021	1,040	1,070
Amount of Scientist Support	14,235	15,425	17,695
Number of Years of Scientist Support	291	300	315
Postdoctoral Support			
Number of Postdoctorals Supported	66	70	78
Amount of Postdoctoral Support	1,004	1,091	1,249
Graduate Students			
Number of Graduate Students Supported	850	900	925
Amount of Graduate Student Support	7,569	8,204	9,403
Other Personnel Costs			
Amount of Support	1,419	1,543	1,768
R&D Facilities, Equipment and Instrumentation			
Land, Buildings and Fixed Equipment	0	0	0
Major Equipment	0	0	0
Other Equipment and Instrumentation	2,105	2,279	2,613
Subtotal, R&D Fac., Equip. and Instrumentation	2,105	2,279	2,613
Other Direct Research Costs**	29,103	31,548	36,145
Indirect Costs	21,779	23,580	27,026
Non-Investment Activities	13,455	14,580	16,711
TOTAL	$90,669	$98,250	$112,610

*Includes "Collection of Information."

**Includes: Supplies, Publications, Consultants, Computer Services, Subcontracts, Travel, and Fringe Benefits.

UNITED STATES POLAR RESEARCH PROGRAMS

Research and Development Special Analysis

	Actual FY 1993	Estimate FY 1994	Estimate FY 1995
Support of R&D		Dollars in Thousands	
Conduct of Research			
Basic Research	$48,673	$53,480	$58,193
Applied Research	159	200	217
Development	0	0	0
Subtotal, Conduct of R&D	48,832	53,680	58,410
(Conduct of R&D Performed by Colleges and Universities.)	(47,546)	(53,680)	(58,410)
R&D Facilities			
Land, Building and Fixed Equipment	1,000	3,000	1,000
Major Equipment	0	0	0
Subtotal, R&D Facilities & Major Equipment	1,000	3,000	1,000
Total, Support of R&D	49,832	56,680	59,410
Non-Investment Activities*	130,945	101,420	103,420
Education and Training	0	0	0
TOTAL	$180,777	$158,100	$162,830

Quantitative Data Table

	Actual FY 1993	Estimate FY 1994	Estimate FY 1995
Proposal Summary		Dollars in Thousands	
Number of Proposals Received	814	911	989
Dollars Requested (Total)	$393,619	$440,696	$478,596
Action Summary			
Number of Awards	406	427	454
Dollars Obligated (Total)	180,777	158,100	162,830
Dollar Distribution by Performer			
Universities	47,546	53,680	58,410
Industry	63,597	84,083	87,883
Federal Agencies	69,634	20,337	16,537
Other	0	0	0
Subtotal, Dollar Distribution by Performer	180,777	158,100	162,830
Personnel			
Senior Scientists			
Number of Scientists Supported	696	730	766
Amount of Scientist Support	7,468	7,841	8,233
Number of Years of Scientist Support	171	179	188
Postdoctoral Support			
Number of Postdoctorals Supported	134	141	148
Amount of Postdoctoral Support	2,051	2,154	2,262
Graduate Students			
Number of Graduate Students Supported	279	293	308
Amount of Graduate Student Support	2,952	3,100	3,255
Other Personnel Costs			
Amount of Support	6,399	6,719	7,055
R&D Facilities, Equipment and Instrumentation			
Land, Buildings and Fixed Equipment	1,000	3,000	1,000
Major Equipment	0	0	0
Other Equipment and Instrumentation	3,960	4,434	4,815
Subtotal, R&D Fac., Equip. and Instrumentation	4,960	7,434	5,815
Other Direct Research Costs**	16,153	18,404	20,814
Indirect Costs	9,849	11,028	11,976
Non-Investment Activities	130,945	101,420	103,420
TOTAL	$180,777	$158,100	$162,830

*Includes "Collection of Information."

**Includes: Supplies, Publications, Consultants, Computer Services, Subcontracts, Travel, and Fringe Benefits.

UNITED STATES ANTARCTIC LOGISTICAL SUPPORT ACTIVITIES

Research and Development Special Analysis

	Actual FY 1993	Estimate FY 1994	Estimate FY 1995
Support of R&D		Dollars in Thousands	
Conduct of Research			
Basic Research	$0	$0	$0
Applied Research	0	0	0
Development	0	0	0
Subtotal, Conduct of R&D	0	0	0
(Conduct of R&D Performed by Colleges and Universities.)	0	0	0
R&D Facilities			
Land, Building and Fixed Equipment	0	0	0
Major Equipment	0	0	0
Subtotal, R&D Facilities & Major Equipment	0	0	0
Total, Support of R&D	0	0	0
Non-Investment Activities*	63,429	62,600	62,600
Education and Training	0	0	0
TOTAL	$63,429	$62,600	$62,600

Quantitative Data Table

	Actual FY 1993	Estimate FY 1994	Estimate FY 1995
Proposal Summary		Dollars in Thousands	
Number of Proposals Received	20	20	10
Dollars Requested (Total)	$80,000	$85,000	$86,000
Action Summary			
Number of Awards	10	10	5
Dollars Obligated (Total)	63,429	62,600	62,600
Dollar Distribution by Performer			
Universities	0	0	0
Industry	6,868	3,800	0
Federal Agencies	56,561	58,800	62,600
Other	0	0	0
Subtotal, Dollar Distribution by Performer	63,429	62,600	62,600
Personnel			
Senior Scientists			
Number of Scientists Supported	0	0	0
Amount of Scientist Support	0	0	0
Number of Years of Scientist Support	0	0	0
Postdoctoral Support			
Number of Postdoctorals Supported	0	0	0
Amount of Postdoctoral Support	0	0	0
Graduate Students			
Number of Graduate Students Supported	0	0	0
Amount of Graduate Student Support	0	0	0
Other Personnel Costs			
Amount of Support	0	0	0
R&D Facilities, Equipment and Instrumentation			
Land, Buildings and Fixed Equipment	0	0	0
Major Equipment	0	0	0
Other Equipment and Instrumentation	0	0	0
Subtotal, R&D Fac., Equip. and Instrumentation	0	0	0
Other Direct Research Costs**	0	0	0
Indirect Costs	0	0	0
Non-Investment Activities	63,429	62,600	62,600
TOTAL	$63,429	$62,600	$62,600

*Includes "Collection of Information."

**Includes Supplies, Publications, Consultants, Computer Services, Subcontracts, Travel, and Fringe Benefits.

CRITICAL TECHNOLOGIES INSTITUTE

Research and Development Special Analysis

	Actual FY 1993	Estimate FY 1994	Estimate FY 1995
Support of R&D		Dollars in Thousands	
Conduct of Research			
Basic Research	$0	$0	$0
Applied Research	0	0	0
Development	0	0	0
Subtotal, Conduct of R&D	0	0	0
(Conduct of R&D Performed by Colleges and Universities.)	0	0	0
R&D Facilities			
Land, Building and Fixed Equipment	0	0	0
Major Equipment	0	0	0
Subtotal, R&D Facilities & Major Equipment	0	0	0
Total, Support of R&D	0	0	0
Non-Investment Activities*	1,000	1,500	2,000
Education and Training	0	0	0
TOTAL	$1,000	$1,500	$2,000

Quantitative Data Table

	Actual FY 1993	Estimate FY 1994	Estimate FY 1995
Proposal Summary		Dollars in Thousands	
Number of Proposals Received	0	0	0
Dollars Requested (Total)	$0	$0	$0
Action Summary			
Number of Awards	0	0	0
Dollars Obligated (Total)	1,000	1,500	2,000
Dollar Distribution by Performer			
Universities	0	0	0
Industry	0	0	0
Federal Agencies	0	0	0
Other	1,000	1,500	2,000
Subtotal, Dollar Distribution by Performer	1,000	1,500	2,000
Personnel			
Senior Scientists			
Number of Scientists Supported	0	0	0
Amount of Scientist Support	0	0	0
Number of Years of Scientist Support	0	0	0
Postdoctoral Support			
Number of Postdoctorals Supported	0	0	0
Amount of Postdoctoral Support	0	0	0
Graduate Students			
Number of Graduate Students Supported	0	0	0
Amount of Graduate Student Support	0	0	0
Other Personnel Costs			
Amount of Support	0	0	0
R&D Facilities, Equipment and Instrumentation			
Land, Buildings and Fixed Equipment	0	0	0
Major Equipment	0	0	0
Other Equipment and Instrumentation	0	0	0
Subtotal, R&D Fac., Equip. and Instrumentation	0	0	0
Other Direct Research Costs**	0	0	0
Indirect Costs	0	0	0
Non-Investment Activities	1,000	1,500	2,000
TOTAL	$1,000	$1,500	$2,000

*Includes "Collection of Information."

**Includes: Supplies, Publications, Consultants, Computer Services, Subcontracts, Travel, and Fringe Benefits.

MAJOR RESEARCH EQUIPMENT (Research & Related Activities)

Research and Development Special Analysis

	Actual FY 1993	Estimate FY 1994	Estimate FY 1995
Support of R&D		Dollars in Thousands	
Conduct of Research			
Basic Research	$0	$0	$0
Applied Research	0	0	0
Development	0	0	0
Subtotal, Conduct of R&D	0	0	0
(Conduct of R&D Performed by Colleges and Universities.)	0	0	0
R&D Facilities			
Land, Building and Fixed Equipment	0	0	0
Major Equipment	34,070	52,000	0
Subtotal, R&D Facilities & Major Equipment	34,070	52,000	0
Total, Support of R&D.	34,070	52,000	0
Non-Investment Activities*	0	0	0
Education and Training	0	0	0
TOTAL	$34,070	$52,000	$0

Quantitative Data Table

	Actual FY 1993	Estimate FY 1994	Estimate FY 1995
Proposal Summary		Dollars in Thousands	
Number of Proposals Received	2	2	0
Dollars Requested (Total)	$34,070	$52,000	$0
Action Summary			
Number of Awards	2	2	0
Dollars Obligated (Total)	34,070	52,000	0
Dollar Distribution by Performer			
Universities	20,000	35,000	0
Industry	0	0	0
Federal Agencies	0	0	0
Other	14,070	17,000	0
Subtotal, Dollar Distribution by Performer	34,070	52,000	0
Personnel			
Senior Scientists			
Number of Scientists Supported	0	0	0
Amount of Scientist Support	0	0	0
Number of Years of Scientist Support	0	0	0
Postdoctoral Support			
Number of Postdoctorals Supported	0	0	0
Amount of Postdoctoral Support	0	0	0
Graduate Students			
Number of Graduate Students Supported	0	0	0
Amount of Graduate Student Support	0	0	0
Other Personnel Costs			
Amount of Support	0	0	0
R&D Facilities, Equipment and Instrumentation			
Land, Buildings and Fixed Equipment	0	0	0
Major Equipment	34,070	52,000	0
Other Equipment and Instrumentation	0	0	0
Subtotal, R&D Fac., Equip. and Instrumentation	34,070	52,000	0
Other Direct Research Costs**	0	0	0
Indirect Costs	0	0	0
Non-Investment Activities	0	0	0
TOTAL	$34,070	$52,000	$0

*Includes "Collection of Information."

**Includes Supplies, Publications, Consultants, Computer Services, Subcontracts, Travel, and Fringe Benefits.

EDUCATION AND HUMAN RESOURCES

Research and Development Special Analysis

	Actual FY 1993	Estimate FY 1994	Estimate FY 1995
Support of R&D		Dollars in thousands	
Conduct of Research			
Basic Research	61,318	68,880	67,963
Applied Research	29,698	30,716	31,266
Development	0	0	0
Subtotal, Conduct of R&D	91,016	99,596	99,229
(Conduct of R&D Performed by Colleges and Universities.)	(78,575)	(86,799)	(86,833)
R&D Facilities	0	0	0
Land, Building and Fixed Equipment	0	0	0
Major Equipment	0	0	0
Subtotal, R&D Facilities & Major Equipment	0	0	0
Total, Support of R&D	91,016	99,596	99,229
Non-Investment Activities*	6,437	10,040	11,340
Education and Training	407,610	459,964	475,431
TOTAL	$505,063	$569,600	$586,000

Quantitative Data Table

	Actual FY 1993	Estimate FY 1994	Estimate FY 1995
Proposal Summary		Dollars in thousands	
Number of Proposals Received	19,135	17,724	18,245
Dollars Requested (Total)	3,381,835	3,004,500	3,043,100
Action Summary			
Number of Awards	2,255	2,638	2,700
Dollars Obligated (Total)	505,063	569,600	586,000
Dollar Distribution by Performer			
Universities	323,665	355,270	363,165
Industry	33,318	40,120	40,975
Federal Agencies	5,684	6,100	6,300
Other	142,396	168,110	175,560
Subtotal, Dollar Distribution by Performer	505,063	569,600	586,000
Personnel			
Senior Scientists			
Number of Scientists Supported	4,549	5,325	5,420
Amount of Scientist Support	54,151	63,007	64,300
Number of Years of Scientist Support	1,126	1,197	1,205
Postdoctoral Support			
Number of Postdoctorals Supported	280	337	341
Amount of Postdoctoral Support	4,391	5,022	5,098
Graduate Students			
Number of Graduate Students Supported	4,072	4,468	4,563
Amount of Graduate Student Support	83,158	66,080	70,190
Other Personnel Costs			
Amount of Support	37,023	46,900	47,350
R&D Facilities, Equipment and Instrumentation			
Land, Buildings and Fixed Equipment	0	0	0
Major Equipment	0	0	0
Other Equipment and Instrumentation	28,978	33,030	33,835
Subtotal, R&D Fac., Equip. and Instrumentation	28,978	33,030	33,835
Other Direct Research Costs**	236,516	283,641	291,135
Indirect Costs	54,409	61,880	62,752
Non-Investment Activities	6,437	10,040	11,340
TOTAL	$505,063	$569,600	$586,000

*Includes "Collection of Information."

**Includes: Supplies, Publications, Consultants, Computer Services, Subcontracts, Travel, and Fringe Benefits.

ACADEMIC RESEARCH INFRASTRUCTURE

Research and Development Special Analysis

	Actual FY 1993	Estimate FY 1994	Estimate FY 1995
Support of R&D		Dollars in Thousands	
Conduct of Research			
Basic Research	$0	$0	$0
Applied Research	0	0	0
Development	0	0	0
Subtotal, Conduct of R&D	0	0	0
(Conduct of R&D Performed by Colleges and Universities.)	0	0	0
R&D Facilities			
Land, Building and Fixed Equipment	37,282	50,000	27,500
Major Equipment	12,472	50,000	27,500
Subtotal, R&D Facilities & Major Equipment	49,754	100,000	55,000
Total, Support of R&D	49,754	100,000	55,000
Non-Investment Activities*	0	0	0
Education and Training	0	0	0
TOTAL	$49,754	$100,000	$55,000

Quantitative Data Table

	Actual FY 1993	Estimate FY 1994	Estimate FY 1995
Proposal Summary		Dollars in Thousands	
Number of Proposals Received	189	550	600
Dollars Requested (Total)	$139,822	$337,500	$370,000
Action Summary			
Number of Awards	66	135	73
Dollars Obligated (Total)	49,754	100,000	55,000
Dollar Distribution by Performer			
Universities	49,433	99,500	54,700
Industry	0	0	0
Federal Agencies	0	0	0
Other	321	500	300
Subtotal, Dollar Distribution by Performer	49,754	100,000	55,000
Personnel			
Senior Scientists			
Number of Scientists Supported	0	0	0
Amount of Scientist Support	0	0	0
Number of Years of Scientist Support	0	0	0
Postdoctoral Support			
Number of Postdoctorals Supported	0	0	0
Amount of Postdoctoral Support	0	0	0
Graduate Students			
Number of Graduate Students Supported	0	0	0
Amount of Graduate Student Support	0	0	0
Other Personnel Costs			
Amount of Support	0	0	0
R&D Facilities, Equipment and Instrumentation			
Land, Buildings and Fixed Equipment	37,282	50,000	27,500
Major Equipment	12,472	50,000	27,500
Other Equipment and Instrumentation	0	0	0
Subtotal, R&D Fac., Equip and Instrumentation	49,754	100,000	55,000
Other Direct Research Costs**	0	0	0
Indirect Costs	0	0	0
Non-Investment Activities	0	0	0
TOTAL	$49,754	$100,000	$55,000

*Includes "Collection of Information."

**Includes Supplies, Publications, Consultants, Computer Services, Subcontracts, Travel, and Fringe Benefits.

MAJOR RESEARCH EQUIPMENT

Research and Development Special Analysis

	Actual FY 1993	Estimate FY 1994	Estimate FY 1995
Support of R&D		Dollars in Thousands	
Conduct of Research			
Basic Research	$0	$0	$0
Applied Research	0	0	0
Development	0	0	0
Subtotal, Conduct of R&D	0	0	0
(Conduct of R&D Performed by Colleges and Universities.)	0	0	0
R&D Facilities			
Land, Building and Fixed Equipment	0	0	0
Major Equipment	0	0	70,000
Subtotal, R&D Facilities & Major Equipment	0	0	70,000
Total, Support of R&D	0	0	70,000
Non-Investment Activities*	0	0	0
Education and Training	0	0	0
TOTAL	$0	$0	$70,000

Quantitative Data Table

	Actual FY 1993	Estimate FY 1994	Estimate FY 1995
Proposal Summary		Dollars in Thousands	
Number of Proposals Received	0	0	2
Dollars Requested (Total)	$0	$0	$70,000
Action Summary			
Number of Awards	0	0	2
Dollars Obligated (Total)	0	0	70,000
Dollar Distribution by Performer			
Universities	0	0	50,000
Industry	0	0	0
Federal Agencies	0	0	0
Other	0	0	20,000
Subtotal, Dollar Distribution by Performer	0	0	70,000
Personnel			
Senior Scientists			
Number of Scientists Supported	0	0	0
Amount of Scientist Support	0	0	0
Number of Years of Scientist Support	0	0	0
Postdoctoral Support			
Number of Postdoctorals Supported	0	0	0
Amount of Postdoctoral Support	0	0	0
Graduate Students			
Number of Graduate Students Supported	0	0	0
Amount of Graduate Student Support	0	0	0
Other Personnel Costs			
Amount of Support	0	0	0
R&D Facilities, Equipment and Instrumentation			
Land, Buildings and Fixed Equipment	0	0	0
Major Equipment	0	0	70,000
Other Equipment and Instrumentation	0	0	0
Subtotal, R&D Fac., Equip. and Instrumentation	0	0	70,000
Other Direct Research Costs**	0	0	0
Indirect Costs	0	0	0
Non-Investment Activities	0	0	0
TOTAL	$0	$0	$70,000

*Includes "Collection of Information."

**Includes: Supplies, Publications, Consultants, Computer Services, Subcontracts, Travel, and Fringe Benefits.

SALARIES AND EXPENSES

Research and Development Special Analysis

	Actual FY 1993	Estimate FY 1994	Estimate FY 1995
		Dollars in Thousands	
Support of R&D			
Conduct of Research			
Basic Research	$0	$0	$0
Applied Research	0	0	0
Development	0	0	0
Subtotal, Conduct of R&D	0	0	0
(Conduct of R&D Performed by Colleges and Universities.)	0	0	0
R&D Facilities			
Land, Building and Fixed Equipment	0	0	0
Major Equipment	0	0	0
Subtotal, R&D Facilities & Major Equipment	0	0	0
Total, Support of R&D	0	0	0
Non-Investment Activities*	110,838	118,300	130,720
Education and Training	0	0	0
TOTAL	$110,838	$118,300	$130,720

Quantitative Data Table

	Actual FY 1993	Estimate FY 1994	Estimate FY 1995
		Dollars in Thousands	
Proposal Summary			
Number of Proposals Received	0	0	0
Dollars Requested (Total)	$0	$0	$0
Action Summary			
Number of Awards	0	0	0
Dollars Obligated (Total)	110,838	118,300	130,720
Dollar Distribution by Performer			
Universities	0	0	0
Industry	0	0	0
Federal Agencies	0	0	0
Other	110,838	118,300	130,720
Subtotal, Dollar Distribution by Performer	110,838	118,300	130,720
Personnel			
Senior Scientists			
Number of Scientists Supported	0	0	0
Amount of Scientist Support	0	0	0
Number of Years of Scientist Support	0	0	0
Postdoctoral Support			
Number of Postdoctorals Supported	0	0	0
Amount of Postdoctoral Support	0	0	0
Graduate Students			
Number of Graduate Students Supported	0	0	0
Amount of Graduate Student Support	0	0	0
Other Personnel Costs			
Amount of Support	0	0	0
R&D Facilities, Equipment and Instrumentation			
Land, Buildings and Fixed Equipment	0	0	0
Major Equipment	0	0	0
Other Equipment and Instrumentation	0	0	0
Subtotal, R&D Fac., Equip. and Instrumentation	0	0	0
Other Direct Research Costs**	0	0	0
Indirect Costs	0	0	0
Non-Investment Activities	110,838	118,300	130,720
TOTAL	$110,838	$118,300	$130,720

*Includes "Collection of Information."

**Includes: Supplies, Publications, Consultants, Computer Services, Subcontracts, Travel, and Fringe Benefits.

NSF HEADQUARTERS RELOCATION

Research and Development Special Analysis

	Actual FY 1993	Estimate FY 1994	Estimate FY 1995
		Dollars in Thousands	
Support of R&D			
Conduct of Research			
Basic Research	$0	$0	$0
Applied Research	0	0	0
Development	0	0	0
Subtotal, Conduct of R&D	0	0	0
(Conduct of R&D Performed by Colleges and Universities.)	0	0	0
R&D Facilities			
Land, Building and Fixed Equipment	0	0	0
Major Equipment	0	0	0
Subtotal, R&D Facilities & Major Equipment	0	0	0
Total, Support of R&D	0	0	0
Non-Investment Activities*	0	5,200	5,200
Education and Training	0	0	0
TOTAL	$0	$5,200	$5,200

Quantitative Data Table

	Actual FY 1993	Estimate FY 1994	Estimate FY 1995
		Dollars in Thousands	
Proposal Summary			
Number of Proposals Received	0	0	0
Dollars Requested (Total)	$0	$0	$0
Action Summary			
Number of Awards	0	0	0
Dollars Obligated (Total)	0	5,200	5,200
Dollar Distribution by Performer			
Universities	0	0	0
Industry	0	0	0
Federal Agencies	0	0	0
Other	0	5,200	5,200
Subtotal, Dollar Distribution by Performer	0	5,200	5,200
Personnel			
Senior Scientists			
Number of Scientists Supported	0	0	0
Amount of Scientist Support	0	0	0
Number of Years of Scientist Support	0	0	0
Postdoctoral Support			
Number of Postdoctorals Supported	0	0	0
Amount of Postdoctoral Support	0	0	0
Graduate Students			
Number of Graduate Students Supported	0	0	0
Amount of Graduate Student Support	0	0	0
Other Personnel Costs			
Amount of Support	0	0	0
R&D Facilities, Equipment and Instrumentation			
Land, Buildings and Fixed Equipment	0	0	0
Major Equipment	0	0	0
Other Equipment and Instrumentation	0	0	0
Subtotal, R&D Fac., Equip. and Instrumentation	0	0	0
Other Direct Research Costs**	0	0	0
Indirect Costs	0	0	0
Non-Investment Activities	0	5,200	5,200
TOTAL	$0	$5,200	$5,200

*Includes "Collection of Information."

**Includes: Supplies, Publications, Consultants, Computer Services, Subcontracts, Travel, and Fringe Benefits.

OFFICE OF INSPECTOR GENERAL

Research and Development Special Analysis

	Actual FY 1993	Estimate FY 1994	Estimate FY 1995
Support of R&D		Dollars in Thousands	
Conduct of Research			
Basic Research	$0	$0	$0
Applied Research	0	0	0
Development	0	0	0
Subtotal, Conduct of R&D	0	0	0
(Conduct of R&D Performed by Colleges and Universities.)	0	0	0
R&D Facilities			
Land, Building and Fixed Equipment	0	0	0
Major Equipment	0	0	0
Subtotal, R&D Facilities & Major Equipment	0	0	0
Total, Support of R&D	0	0	0
Non-Investment Activities*	3,687	3,997	4,380
Education and Training	0	0	0
TOTAL	$3,687	$3,997	$4,380

Quantitative Data Table

	Actual FY 1993	Estimate FY 1994	Estimate FY 1995
Proposal Summary		Dollars in Thousands	
Number of Proposals Received	0	0	0
Dollars Requested (Total)	$0	$0	$0
Action Summary			
Number of Awards	0	0	0
Dollars Obligated (Total)	3,687	3,997	4,380
Dollar Distribution by Performer			
Universities	0	0	0
Industry	0	0	0
Federal Agencies	0	0	0
Other	3,687	3,997	4,380
Subtotal, Dollar Distribution by Performer	3,687	3,997	4,380
Personnel			
Senior Scientists			
Number of Scientists Supported	0	0	0
Amount of Scientist Support	0	0	0
Number of Years of Scientist Support	0	0	0
Postdoctoral Support			
Number of Postdoctorals Supported	0	0	0
Amount of Postdoctoral Support	0	0	0
Graduate Students			
Number of Graduate Students Supported	0	0	0
Amount of Graduate Student Support	0	0	0
Other Personnel Costs			
Amount of Support	0	0	0
R&D Facilities, Equipment and Instrumentation			
Land, Buildings and Fixed Equipment	0	0	0
Major Equipment	0	0	0
Other Equipment and Instrumentation	0	0	0
Subtotal, R&D Fac., Equip. and Instrumentation	0	0	0
Other Direct Research Costs**	0	0	0
Indirect Costs	0	0	0
Non-Investment Activities	3,687	3,997	4,380
TOTAL	$3,687	$3,997	$4,380

*Includes "Collection of Information."

**Includes: Supplies, Publications, Consultants, Computer Services, Subcontracts, Travel, and Fringe Benefits.

WEDNESDAY, MARCH 23, 1994.

OFFICE OF SCIENCE AND TECHNOLOGY POLICY

WITNESSES

DR. JOHN H. GIBBONS, DIRECTOR
DR. M R C GREENWOOD, ASSOCIATE DIRECTOR, SCIENCE
LIONEL S. JOHNS, ASSOCIATE DIRECTOR, TECHNOLOGY
JANE WALES, ASSOCIATE DIRECTOR, NATIONAL SECURITY AND INTERNATIONAL AFFAIRS
BARBARA FERGUSON, ADMINISTRATIVE OFFICER
ANGELA PHILLIPS DIAZ, EXECUTIVE SECRETARY, NATIONAL SCIENCE AND TECHNOLOGY POLICY
MARK SCHAEFER, ASSISTANT DIRECTOR FOR DEVELOPMENT
SUE BACHTEL, SPECIAL ASSISTANT TO THE DIRECTOR

CHAIRMAN'S INTRODUCTION

Mr. STOKES. The committee will come to order. At this time we want to welcome before the subcommittee once again Dr. John H. Gibbons, the Director of the Office of Science and Technology Policy.

It is a pleasure to have you back before our subcommittee. The OSTP is requesting $5 million, 40 FTE and six detailees for fiscal year 1995.

Dr. Gibbons, We would be pleased to have you introduce anyone else who is with you this morning.

INTRODUCTION OF OSTP OFFICIALS

Mr. GIBBONS. Thank you, Mr. Chairman.

I would like to introduce to the committee those behind me. That is why I feel so good this morning. I am backed up with some very fine people.

Barbara Ferguson, who you may have met, our Administrative Officer at OSTP. Dr. M. R. C. Greenwood, who is our Associate Director for all of the Sciences at OSTP. She comes from California.

Ms. Jane Wales, who is our Associate Director for National Security and International Affairs. Mr. Johns, who I think you may have met before, our Associate Director for Technology. Mark Schaefer, who is Assistant Director for Environment. Dr. Robert Watson was unable to be with us this morning. Mark is Bob's number two person, and these form the four divisions of OSTP.

I would like to introduce Angela Phillips Diaz, who is Executive Secretary of the National Science and Technology Council. The assistant at the end in green—this is not St. Patrick's Day—that is Sue Bachtel, who is my direct assistant.

Mr. STOKES. Thank you, very much. It is a pleasure to welcome all of you here accompanying the Director before our committee this morning.

We have your full statement, which we will place in the record at this time. You may proceed in any way you would like.

OSTP DIRECTOR'S OPENING STATEMENT

Mr. GIBBONS. Thank you, Mr. Chairman. I appreciate that.

I think this committee understands and appreciates full well the administration's commitment to science and technology, a key investment in providing for the kind of future that we hope for our Nation. A future that is directed towards such national goals as a resilient economy, a healthy population, a clean environment, and a secure defense.

And I would like to describe just quickly six strategies that follow from that commitment to investment.

First, we want to maintain research and development as a priority investment even in the face, as you full well are sensitized to, of a budget where overall we basically have a zero sum game.

That is if you are going to do something new, you have to stop something old or improve your efficiency so that you have some extra capability. But even in the face of that, we want to maintain R&D as a priority investment.

Second, we want to focus that investment on key national goals. We are therefore trimming in some places in order to provide for increases in essentially a fixed budget, increases in areas such as health research, environmental technologies, national information infrastructure, energy efficiency, and technology partnerships with industry so that we can provide for the capability, provide the opportunity for science and technology to make new options in order to achieve our national goals.

We are placing a very high priority on technology because we feel it is intimately linked to economic growth and to the creation of good jobs for our people and improvement in the quality of life and our environment.

The third part of six part strategy is that we are trying to ensure our leadership in fundamental research. Fundamental research is an ultimate driver connected with and resonating with technology development. That provides for new options, new ways not only to understand how things work in this world, but how to take advantage of that knowledge.

Now, we want to maintain a strong fundamental science and engineering research base and sustain its role in keeping us in world leadership in terms of science and technology and our work force that goes with that.

In your examination, as you full well know, of a budget such as that of the NSF and the NIH, those budgets for fiscal year 1995 are requested to be increased even in the face of a zero sum game. One reason I feel personally so strongly about this is that by virtually every measure, science research has had, historically, one of the highest social rates of return of any investment we have made as a people. And we feel that that string continues and that it is very important to keep this as a long-term investment strategy.

Fourth, we are trying to improve our strategic coordination of our science and technology programs. I think you will see some evidence of this in the fiscal year 1995 budget, and we are working hard already in preparation of guidance for the 1996 budget.

The long-term success in effecting shifts in priority in our budget depends on not only a strong presidential leadership in this regard and close cooperation between the administration and the Congress, but also between government and the private sectors. Accordingly, and reflective of the National Performance Review and the idea of Reinventing Government, the President established in late November the National Science and Technology Council and the President's Committee of Advisors on Science and Technology in order to improve our ability in the Executive Branch to access the full power of science and technology.

And through the NSTC, the National Science and Technology Council, I think we have already made some important steps in this direction.

For instance, we have established a partnership for a new generation of vehicles, which is an interesting partnership aligning the public's interest in pollution controls and providing a more secure energy future and good jobs with the private sector interest in building automobiles that will be commercially not only viable, but competitive in world markets. And this kind of partnership has come out of this first year of activity.

We are focused on environmental technologies with the environmental technology bill before the House now. We are strengthening nonproliferation and arms controls regimes. I am sure you have seen and are pleased with the work we are doing on securing weapons grade plutonium and uranium, for example. I know you are familiar with our work on national information infrastructure.

So all of these activities reflect this council's cross-agency capability that we now have at the Secretary or so-called Cabinet level that enables us to do this kind of negotiation and working between the agencies. The net result is that the administration has created what I would call a virtual science and technology agency by combining at the highest level an ability to integrate these programs in a way that we just haven't done before.

I am reminded of someone describing a major university as a series of essential independent deanships and departments loosely connected by a common heating plant. Sometimes you can think of the government agencies in the same way. Our aim is to have more than a common heating plant in connecting these agencies together.

PUBLIC/PRIVATE PARTNERSHIPS

Fifth, Mr. Chairman and Members, we are trying to expand our partnerships with the private sector. We believe that the past kind of standoff and all too frequently adversarial relationship between the government of the people and the private sector is one that could be improved on by providing, under the right circumstances, partnerships where we can work together on areas of common cause and where the self-interest of the stakeholders is very clear.

The technology reinvestment project which is a centerpiece of the President's defense conversion activity is a good example. Under ARPA the Department of Defense seamlessly engaged with five other government agencies to work with industry on a cost-shared, peer reviewed process of helping transform our defense industry into one that is dual use. We must convince industry to market in defense areas as well as in commercial areas. We hope to see a transformation all the way to where they are focused now on the civilian side of the equation.

This is also happening at the Department of Commerce in the National Institute of Standards and Technology with their advanced technology programs aimed at very advanced manufacturing technologies and the transfer of that kind of information especially to small and medium-sized businesses.

You know last year we had a 2 million job gain during the year, but we lost in manufacturing again, and that is where the jobs are in the long run. So we feel we have an interest in making ourselves more competitive in these areas and in assuring that technology ingenuity is focused on this and that it is transferable even to the small companies that can use it and stay competitive.

The President's Science Advisory Committee enables us to make sure that we pull in the wisdom of people outside government in helping this government operate more efficiently.

And finally, we are creating opportunities for international cooperation. As you know, in science and technology, as the very nature of some of these programs moves along, they get very big and very complicated. We have all been through the very discomforting time now of talking about particle physics and the superconducting supercollider.

We are in the midst of transforming the NASA and the space station. We are getting ready to face such things as fusion activities and other major science and technology areas where it makes every bit of good sense to move these towards truly international ventures where we can hold on to our national interest and at the same time drive some cost sharing by that process.

So to sum it up, I would like to reiterate that the administration is treating science and technology as high leverage investments in our present and future. At the same time, we are facing with you an absolute urgency to keep our budgets tight and see the money used more efficiently.

THEORY OF HOLES

I have called it the theory of holes. That is if you are in a hole like our department, the first thing to do is stop digging, and we are working hard at that. At the same time, if a hole is deep enough, you have got to also figure out a way to climb out of it, and that means investment and that is why we feel so strongly that investment in this area is so important for us.

In order to do this, and to pull this program together across the agencies, the White House has to have the capability at the Cabinet level and the requisite human resources in science and technology to work at the highest level in government.

OSTP BUDGET REQUEST

To make these things happen, to transform our defense dominated research and development agenda to one that is more balanced, we can't depend on inexperienced people. And if you look at our budget request, about 85 percent of the $.5 million increase goes to that business of the salaries, the compensation for the kinds of senior scientific professionals that we need.

It also accommodates for this year the convening of the President's Committee of Advisors on Science and Technology and for the work in the NSTC. The budget is at $5 million, still $1 million or 20 percent lower than the combined FY '93 budget of the OSTP, the Space Council, and the Critical Materials Council, which we have now merged together.

So we hope you will look with favor on our request, Mr. Chairman, and I would be happy to take any remarks or comments you may have.

Mr. STOKES. Thank you very much, Dr. Gibbons. We will start with some general questions.

[The information follows:]

January 1994

BIOGRAPHICAL SKETCH OF JOHN H. (JACK) GIBBONS

Dr. John H. (Jack) Gibbons took the oath of office as Assistant to the President for Science and Technology and Director, Office of Science and Technology Policy, on February 2, 1993. In these capacities, Dr. Gibbons is charged with providing access to authoritative information and expert scientific, engineering and technological advice for the President, Congress, and other Federal officials, and with coordinating science and technology policy throughout the Federal Government.

Prior to his appointment by President Clinton and since 1979, Dr. Gibbons directed the Congressional Office of Technology Assessment (OTA). OTA provides Congress a source of information on complex science and technology issues that is nonpartisan, expert, objective, and anticipatory.

Dr. Gibbons is an internationally recognized scientist, an expert in energy and environmental issues, and a man with a deep interest and concern regarding the impacts of technology on society and what these impacts imply for the formulation of sound public policy. Before his congressional appointment, Dr. Gibbons served as the Director of Energy, Environment, and Resources Center at the University of Tennessee. Prior to that, at the Oak Ridge National Laboratory, he conducted physics research and later directed projects on energy and materials conservation and on the environmental consequences of power production. In 1973-1974, as the first Director of Energy Conservation for the Federal Energy Administration, he initiated and directed overall Federal programs in research, development, and demonstration on energy conservation.

His past public sector advisory activities have included chairmanship of the Demand/Conservation Panel for the National Academy of Sciences Committee on Nuclear and Alternative Energy Systems (CONAES) and membership on the Energy Research Advisory Board of the U.S. Department of Energy. He has served on the Board of Trustees and Board of Associates of Randolph-Macon College, the Board on Science and Technology for International Development (BOSTID) of the National Academy of Sciences, the Board of American Association for the Advancement of Science, and the Board of Resources for the Future. He has also served on the Electric Power Research Institute (EPRI) Advisory Council; the Long-Range Planning Committee of Sigma Xi; the Aspen Institute/Energy and Resources Committee; the Carnegie Commission on Science, Technology and Government Task Force on Long-Term Goals and Priorities; and the Board of the Energy Foundation.

Dr. Gibbons is a graduate of Randolph-Macon College and Duke University (Ph.D., Physics). He is a Fellow of both the American Physical Society and the American Association for the Advancement of Science, and is a member of the Council on Foreign Relations.

In 1990, Dr. Gibbons received the Federation of American Scientists Public Service Award; in 1991, the American Physical Society Leo Szilard Award for Physics in the Public Interest. Also in 1991, the President of Germany awarded Dr. Gibbons the Officer's Cross of the Order of Merit to recognize his contributions to German-American cooperation in science and technology. In 1994, Dr. Gibbons was elected to membership in the National Academy of Engineering.

Subjects of his publications range from experimental nuclear physics to the influence of energy price and technology on future energy demand.

M.R.C. GREENWOOD, Ph.D.

ASSOCIATE DIRECTOR OF SCIENCE OFFICE OF SCIENCE AND TECHNOLOGY POLICY

Dr. M.R.C. Greenwood was appointed to the position of Associate Director of Science at the Office of Science and Technology Policy in the Executive Office of the President, and was confirmed by the United States Senate on November 10, 1993.

She previously served as Dean of Graduate Studies at the University of California at Davis from 1989 to 1993. She came to UC Davis from Vassar College where she was the John Guy Vassar Professor of Natural Sciences, Chair of the Department of Biology, and Director of the Undergraduate Research Summer Institute.

In 1992, Dr. Greenwood was elected to the Institute of Medicine of the National Academy of Sciences. She has served as Director of the NIH Obesity Research Center Animal Model CORE Laboratory; chair of the Food and Nutrition Board of the Institute of Medicine of the National Academy of Sciences; member of the NIH Nutrition Study Section; President of the North American Association for the Study of Obesity and was Vice President Elect of the American Society for Clinical Nutrition. Dr. Greenwood graduated summa cum laude from Vassar College and received her Ph.D. from The Rockefeller University. She did postdoctoral research on human nutrition and genetics at the Institute for Human Nutrition at Columbia University, and was an assistant professor there. In 1978 she returned to Vassar as Associate Professor of Biology; she became full professor in 1981. She has taught many graduate and undergraduate courses including introductory biology, human sexuality, nutrition, biochemistry and mammalian physiology.

At UC Davis, Dr. Greenwood was appointed Professor in the Departments of Nutrition and Internal Medicine. Her research interests are in developmental cell biology, genetics, physiology and nutrition. Her work over the past 25 years, focusing on the genetic causes of obesity, is recognized world-wide. In 1982 she was honored for significant contributions to nutrition research by the American Institute of Nutrition. She has been a principal investigator on numerous federal and foundation grants. Dr. Greenwood is the author of over 200 scientific publications and presentations. She has been a member of several editorial boards including the Journal of Nutrition and Obesity Research and has been a consultant for several lay and professional organizations. Dr. Greenwood has served on the Executive Committee of CRPGE of the National Association of State Universities and Land Grant Colleges and the Executive Committee of the Western Association of Graduate Schools.

Dr. Greenwood was also Reporting Dean for the Division of Education and a member of several groups and councils on the Davis campus, including the Council of Vice Chancellors, the Council of Vice Chancellors and Deans, The Academic Planning Council, the Biological Sciences Council, the Graduate Council, the Campus Development Council, the Financial Aid Work Group, and the Affirmative Action Work Group. Dr. Greenwood was formerly Chair of the University of California Council of Graduate Deans and served on the Joint Graduate Board (California State University/University of California).

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
WASHINGTON, D.C. 20500

January 1994

LIONEL SKIPWITH ("SKIP") JOHNS

Mr. Lionel Johns is the Associate Director for Technology in the Office of Science and Technology (OSTP) within the Executive Office of the President. He reports to Dr. John Gibbons, Director of OSTP and Assistant to the President for Science and Technology. At OSTP, Mr. Johns is responsible for technology R&D policy coordination between Federal agencies. These activities, coordinated through the National Science and Technology Council (NSTC), include space and aeronautics, industrial R&D, defense conversion, information and communications (including "the information superhighway"), and education and training technologies. He serves as White House Co-Chair of three NSTC committees: Information and Communication R&D, Civilian Industrial Technology R&D, and Transportation R&D.

Prior to joining OSTP, Mr. Johns served as Assistant Director of the Office of Technology Assessment (OTA), which was created in the Legislative Branch to provide the U.S. Congress with objective non-partisan analysis of major public issues related to the development and use of technology. Mr. Johns' Division at OTA was responsible for the analysis of industrial competitiveness, quality of the work force, energy, materials, national security, space, and international technology transfer and trade.

Mr. Johns has 16 years of experience in management in high technology industries. He gained them at Ocean Science and Engineering, Inc., Hazeltine Corporation, the Magnavox Company, and General Instrument Corporation. He worked on projects involving the design, development, and production of radars, communications, sonar, and command and control systems. Marine experience included management and sales of ship design, ship operations, mineral exploration, and ocean engineering systems. Mr. Johns also spent several years in corporate finance at Alex Brown & Sons.

Immediately upon earning his Bachelor of Science degree from the University of Virginia, he served as an officer in the United States Navy as a carrier-based naval aviator.

He has participated in numerous international meetings in Asia, Europe, and Africa on arms control, energy, trade, and third world development. Mr. Johns is a member of the Council on Foreign Relations and serves on the Critical Technologies Subcouncil of the Competitiveness Policy Council. He was elected a Fellow of the American Association for the Advancement of Science.

Jane Wales

On November 15, 1993, Jane Wales was sworn in as Associate Director for National Security and International Affairs in the Office of Science and Technology Policy. Ms. Wales also serves as Special Assistant to the President and Senior Director for Science and Technology on the National Security Council staff.

Ms. Wales was formerly chair of the Carnegie Corporation Program on Cooperative Security. Prior to joining the Corporation in 1990, she was director of the Secure Society Program of the W. Alton Jones Foundation, in Charlottesville, Virginia.

Ms. Wales is a former Deputy Assistant Secretary of State and served in the White House as Coordinator of Public Liaison from 1977-79. Before joining the Carter Administration, she was a writer at "Congressional Quarterly" and was Managing Editor of the "Democratic Review" magazine. From 1982-87, Ms. Wales was National Executive Director of Physicians for Social Responsibility, the U.S. affiliate of the International Physicians for the Prevention of Nuclear War, winner of the 1985 Nobel Peace Prize.

In 1987 and 1988, Ms. Wales directed the International Security Options Project, which developed recommendations for U.S. nuclear weapons policy, under the guidance of Gerard Smith, George Kennan, Robert McNamara and others. As part of that affiliation, Ms. Wales assisted Mr. McNamara in the research and organization of Out of the Cold (Simon & Shuster, 1989).

Ms. Wales has been a member of the national governing board of Common Cause and a member of the Council on Foreign Relations. She is a graduate of Sarah Lawrence College.

Short Resume

September 10, 1993

ROBERT T. WATSON

PRESENT [illegible]TION:
Associate Director for Environment, Office of Science and Technology Policy,
Old Executive Office Building, Washington, D.C.

[illegible]ERTISE:
Environmental Issues - Emphasis on Climate and Ozone

EDUCATION:
Ph.D., (Gas Phase Chemical Kinetics) - 1973 — Queen Mary College, London University, London, England
B.Sc. 1st class (chemistry) - 1969 — Queen Mary College, London University, London, England

PREVIOUS POSITIONS:
Director, Science Division, and Chief Scientist (Acting), Office of Mission to Planet Earth
National Aeronautics and Space Administration, Washington, D.C. - 1993 - present
Director, Process Studies Program Office, Earth Science and Applications Division – 1990-1993
Branch Chief for Upper Atmospheric Research and Tropospheric Chemistry Programs –1987-1990
Acting Program Scientist (NASA) - 1980-1987
for (1) Upper Atmosphere Research Program; (2) Interdisciplinary Earth Science Research Program, and
(3) Global Habitability Initiative — Detailee from the Jet Propulsion Laboratory

Jet Propulsion Laboratory, Pasadena, CA
Research Scientist - 1980-1987; Member of the Technical Staff - 1978-1980; Senior Scientist - 1976-1978

Postdoctoral Research Scientist
University of Maryland, College Park, MD - 1974-1976; University of California, Berkeley, CA - 1973-1974

AWARDS:
Climate Institute Scientific Achievement Award for Coordinating International Scientific Assessments - 1993
American Association for the Advancement of Science Award for Scientific Freedom and Responsibility - 1993
American Meteorological Society Special Award "for notable efforts in organizing and conducting international assessments in ozone depletion and global change" - 1993
National Academy of Sciences Award for Scientific Reviewing - 1992
American Geophysical Union's Edward A. Flinn Award - 1991
Designated member of UNEP's "The Global 500: The Roll of Honour for Environmental Achievement" - 1989
NASA Group Achievement Award (EOS) - 1993
NASA Cooperative External Achievement Award (High Speed Research Program) - 1992
NASA Distinguished Service Medal - 1989
NASA Public Service Group Achievement Award (Antarctic Aircraft Ozone Expedition) - 1989
NASA Group Achievement Award (International Ozone Trends Panel) - 1989
NASA OSSA - Edelson Award - 1987
NASA Public Service Group Achievement Award (International Ozone Assessment) - 1986
NASA Exceptional Service Medal - 1983

SPECIAL EXPERIENCE:

Chair of the Science and Technical Advisory Panel to the Global Environmental Facility (World Bank, United Nations Development Program, and United Nations Environment Programme) 1991-

Co-chair: Intergovernmental Panel on Climate Change (IPCC) Working Group II - Impacts, Adaptation, and Mitigation, 1993-

Co-chair: International WMO/UNEP Scientific Assessments of the Current Knowledge of the Processes Controlling the Abundance and Distribution of Atmospheric Ozone, 1985, 1988, 1989, 1991, and 1994

Chair: UNEP/WMO Synthesis Panel for international Ozone Assessment (Science, Impacts, Technology, and Economics), 1989, 1991, 1994

Chair: UNEP Global Biodiversity Assessment - 1993-

Chair: UNEP/WMO Synthesis Panel for Methyl Bromide (Science, Technology, and Economics) - 1992

U.S. Representative on the Intergovernmental Panel on Climate Change (IPCC) Science Working Group and Member of Steering Group for IPCC. Chaired Chapter on Greenhouse Gases for the IPCC Scientific Assessment for Working Group I (1990 and 1992)

Technical Advisor for the U.S. Government for both bilateral and multilateral negotiations of the Vienna Ozone Convention and the Montreal (CFC) Protocol

Technical Advisor for the U.S. Government on Climate Change and member of the U.S. delegation to the International Negotiation Committee on Climate Change

[illegible]air: Committee on Earth and Environmental Sciences (CEES) Assessment Working Group

Testified many times before U.S. Senate and U.S. House of Representatives Committees and Sub-Committees on Ozone, Global Warming, and other Global Change Research issues

NASA Representative to Office of Science and Technology Policy, Committee on Earth and Environmental Sciences, Global Change Working Group

BARBARA ANN FERGUSON

Ms. Ferguson joined the Office of Science and Technology Policy (OSTP) as the Administrative Officer in September of 1990. In this position, she is responsible for the OSTP Administrative Office and all matters concerning the budget, financial management, contracting, personnel, security, space, supplies and equipment. In addition, she serves as the agency liaison for Federal Advisory Committee Management, the alternate ethics officer and the Freedom of Information Act coordinator.

Prior to joining OSTP, Ms. Ferguson was the Administrative Support Specialist for the Office of Emergency Operations (OEO) from January 1988 until September 1990. She was responsible for providing administrative/office management support to the Office of Security of the OEO. Ms. Ferguson managed the office budget and assisted the contracting officer representatives in the monitoring of five contracts totalling several million dollars worth of effort. She was responsible for drafting statements of work, drafting contract-related correspondence, and preparing and staffing funding requests in relation to contracts.

From April 1981 to January 1988, Ms. Ferguson worked for JAYCOR, a high-technology research and development firm in Vienna, Virginia. During that time period she served in a variety of functions including being instrumental in the creation of a subsidiary company, JAYCOR Technical Services Company.

Ms. Ferguson worked for the Naval Electronic Systems Command as Personal Secretary to the Program Manager of Command, Control, Communications and Intelligence (C3I) from 1976 to 1980.

Prior to that she worked for the Naval Supply Systems Command from 1974 to 1976.

Ms. Ferguson is a 1972 graduate of the Katharine Gibbs School in Montclair, New Jersey.

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
WASHINGTON, D.C. 20500

Statement of

The Honorable John H. Gibbons, Director
Office of Science and Technology Policy

before the

Subcommittee on Veterans' Administration, HUD, and Independent Agencies
Committee on Appropriations
U.S. House of Representatives

March 23, 1994

Mr. Chairman, Members of the Committee, I am pleased to appear before you today to discuss OSTP's budget request for Fiscal Year 1995. I will also provide a brief overview of the Clinton Administration's science and technology strategy, in which OSTP played a key development role and continues to play a leadership role.

The Clinton Administration treats science and technology as high-leverage investments in America's present and future. Investments in S&T contribute to: a growing economy with more high-skill, high-wage jobs for American workers; a cleaner environment where energy efficiency, information technology, and advanced science and engineering help increase profits and reduce pollution; greater access to high quality health care; national security; a stronger, more competitive private sector able to maintain U.S. leadership in critical world markets; an educational system where every student is challenged; and an inspired scientific and technological research community focused on ensuring not only our national security but quality of life for ourselves and our children. The most important measure of success will be our ability to make a difference in the lives of the American people, to harness science and technology to improve the quality of life and the economic vitality of our nation.

The Office of Science and Technology Policy (OSTP) supports these objectives by: providing authoritative scientific and technological information, analysis, advice, and recommendations for the President, for the Executive Branch, and for Congress; participating in the formulation, coordination, and implementation of national and international policies and programs that involve science and technology; maintaining and promoting the health and vitality of the U.S. science and technology infrastructure; and coordinating research and development efforts of the Federal government to maximize the return on the public's investment in science and technology and to ensure that resources are used efficiently and appropriately.

SCIENCE AND TECHNOLOGY STRATEGY

President Clinton and Vice President Gore recognize science and technology as foundations of our Nation's future. To help ensure the health and welfare of U.S. citizens, the Administration has adopted a 6-point strategy for science and technology.

First, we are maintaining R&D funding as a priority investment. We are fighting hard to protect the federal investment in R&D by advocating the importance of investing in our future even as we continue our very serious commitment to cut the deficit.

We believe, though, that our R&D investment portfolio must adapt to changing times. Defense build up and focus on Cold War scenarios must yield to a new force structure and defense technology base reflecting changed world conditions. Our emphasis must now shift to civilian programs that can also operate as critical elements of a defense technology base. Historical federal agency missions and assets must yield to evolving national goals.

In the President's budget request for Fiscal Year 1995, the commitment to R&D is evident. Total R&D spending will increase by 3%. Keep in mind that these increases appear in a budget that, overall, represents not a zero sum game but a negative sum game -- in which discretionary spending declines. These numbers reflect true commitment within the Administration -- a willingness to experience pain elsewhere in order to support research and development.

The civilian share of R&D, with dual use spending included, comes in at 47%. We will continue to make progress toward our goal of at least equalizing civilian and defense demands on the R&D investment by 1998.

Next, we are focusing on key national goals. For example, we propose to increase spending on health research by 4%, on environmental technologies by 11%, and on energy efficiency R&D by 42%. The Department of Commerce, which through the National Institute for Standards and Technology (NIST) runs many of our programs of technology partnerships with industry, is slated for a 31% increase in its budget.

This Administration is placing an extremely high priority on technology because of its linkage to economic growth, good job opportunities, quality of life, and the environment in which we live. One of the innovations in our new technology policy is that it explicitly recognizes the crucial role the federal government can play in working with the private sector to develop and transition innovative ideas and technologies to the commercial marketplace and for government use.

Point 3, we are ensuring this Nation's leadership in fundamental research. The force pushing industrial commercialization and the leading edge of research closer together -- the drive for international competitiveness -- reinforces the conviction, within government and industry, that we must maintain a strong base in fundamental science and engineering research and sustain its role in producing a world class science and technology workforce.

But this does not mean that fundamental research escapes the requirement of reform. We've run up against limits on resources even as many fundamental research projects grow bigger and more expensive.

Fourth, we are improving strategic coordination of S&T programs. You see in the FY '95 budget that we have set new funding priorities. But long-term success in affecting funding priorities requires a presidential mandate and close cooperation between the Administration and the Congress, as well as between the public and private sectors. President Clinton has established two new institutions of governance, the National Science and Technology Council -- NSTC -- and a broadened President's Committee of Advisors on Science and Technology -- PCAST -- to improve our ability to access the power of science and technology.

The President chairs the NSTC, which includes the Vice President, Cabinet Secretaries, agency heads, and key White House officials, and which is responsible for coordinating overall science and technology strategies and policies. One of the most critical tasks the NSTC is undertaking is preparation of an integrated overview of federal investment in research and development. The Council will prepare coordinated, strategic priorities for accomplishing national objectives in conjunction with agency missions. In this way, the NSTC will act as a "virtual" science and technology agency, utilizing to the fullest the diverse assets and expertise that exists throughout the government and its contractors.

We have established R&D Coordinating Committees designed to enable us to produce, for the first time in the Federal Government's history, an R&D budget request that fully integrates the missions of the agencies and the overarching science and technology requirements of the Nation. NSTC Committees working on the FY '96 budget request include:

- Health, Safety, and Food R&D
- Fundamental Science Research
- Information and Communication R&D
- Environment and Natural Resources Research
- National Security R&D
- Civilian Industrial Technology R&D
- Education and Training R&D
- Transportation R&D
- International Science, Engineering, and Technology R&D

Each committee operates with a Department Chair (or co-chairs), a White House Co-Chair, and a Department Vice-Chair. In the course of developing budget requests, the Committees will assist the NSTC in establishing priorities for research and development, in generating criteria for evaluating progress toward national goals for science and technology, and in refining those goals as science and technology evolve. NSTC's role in crafting R&D budgets that capitalize on agency strengths and eliminate waste and duplication in these stringent budget years is critical to the success of this Administration and to continued government support for research.

Despite the intense focus on the budget, the need for an NSTC has also been evinced in several general policy areas. For instance:

Fundamental Science. The Committee on Fundamental Science Research cosponsored, on January 31 and February 1, a forum on Science in the National Interest to help articulate the: 1) benefits of our national investment in fundamental science; 2) principles and practices influencing the conduct of basic research; 3) challenges and opportunities facing U.S. efforts in fundamental science; and 4) goals for a 21st century science policy. World leadership in science, mathematics, and engineering is an explicit goal of this Administration, and this NSTC effort is an essential step toward realizing that goal.

Biotechnology. Biotechnology can play a critical role in our nation's future technological strength and economic growth, in preservation and restoration of the environment and biodiversity, and the health and quality of life of all people. The revolution in life science research that has vastly increased our understanding of the living world offers expanding opportunities to use this knowledge for the welfare of the Earth and humankind. The Biotechnology Research Subcommittee (of the Fundamental Science Research Committee) of the NSTC will provide government-wide coordination and focus for biotechnology research in the various Federal departments and agencies. We expect to emphasize the following areas: environmental biotechnology; bioprocessing and bioconversion; agricultural biotechnology; marine biotechnology; and the social and economic dimensions of biotechnology.

U.S. Global Change Research Program. Under NSTC's direction, this program's mandate has been broadened to make it more policy relevant. Several key areas are now being augmented: socio-economic impacts; ecological research; and integrated assessment. OSTP will work in the months ahead with other members of the NSTC on the long-term strategy for budget, technology, R&D, regulatory, and economic policies that could impact greenhouse gas emission levels beyond the year 2000.

Environmental Technologies. Numerous departments and agencies contribute to research, development, and commercialization of environmental technologies, an area of great, potential economic growth for the United States. Through the NSTC, the Administration is working to develop a comprehensive strategy to ensure these programs are effectively coordinated and directed toward national needs.

Education and Training. Advanced learning technologies represent an important growth opportunity for many emerging businesses. Under the NSTC, we have initiated a program designed to apply the results of Defense Department research in advanced training technologies to the requirements of education and training identified in other agencies.

> **Bioethics**. Views throughout the Nation -- in the private sector, legislative branch, and executive branch -- have converged on the need for high-level attention to bioethical issues. As a result, NSTC is considering, in consultation with the Congress, creation of a Bioethics Policy Committee and an advisory committee to inform the workings of the interagency group. Programs and policies of multiple Federal agencies have direct bioethical implications, and NSTC could serve as a forum for interagency policy development for critical research issues.

A fifth point in the strategy -- and an adjunct to point 4 -- we are expanding our partnerships with the private sector. As I mentioned, NIST has a central mission responsibility to work with industry in promoting economic growth and in creating jobs. Other agencies share this responsibility. For instance, the Technology Reinvestment Project, a centerpiece of the President's defense conversion program, is chaired by ARPA, within the Defense Department, but operated jointly by six agencies. Like NIST, it has been remarkably successful in creating partnerships with industry, universities, and State and local agencies for the development of new technologies and deployment existing best-practice technologies. These partnerships are chosen purely by merit, co-funded by industry participants and government, and are carried out with strict milestones, performance evaluation, and time limits.

The great increase in cost-shared Cooperative Research and Development Agreements (CRADAs) between industry and our government laboratories is also testament to our commitment to U.S. competitiveness and economic growth. More than 2000 CRADAs have already been signed, and we expect hundreds more to be concluded this year. Again, these are conditioned on merit and joint funding with industry.

As I mentioned before, the President has also established a new PCAST to ensure private sector advice to the NSTC. Involvement of distinguished individuals from industry, education, and research institutions with the NSTC will be essential to developing successful science and technology policies that help American businesses achieve sustainable growth and create high quality jobs, as well as to maintaining our academic and research institutions' world leadership in science, engineering, and mathematics. One goal for PCAST is to help create public/private partnerships and make them work successfully.

With these new institutions, I believe the Administration can improve the overall effectiveness of federal science and technology for national and global objectives. The NSTC provides a structure in which to prioritize the many legitimate demands on the public's R&D dollar. It can sensitize agencies to the advantages of symbiosis over isolated pursuit of narrow objectives. Within this framework, we can illuminate the myriad roles for science and technology and weave their tremendous power throughout the complex tapestry of national and international affairs.

Even without our new institutions fully in place, we are beginning in the United States to overcome the inertia of the situation we inherited just over a year ago. For example, the Administration has:

- forged the clean car initiative, a historic alliance with the nation's big three automakers to develop a new generation of cars and trucks that meet the performance expectations of consumers and are affordable and virtually pollution free. Government and industry research organizations have jointly accepted a set of ambitious technical objectives that are critical for ensuring continued competitiveness of a critical national industry.
- launched the Technology Reinvestment Project (TRP) to stimulate a public and private sector transition from defense-specific technologies to dual use technologies that have both military and civilian applications.
- expanded threefold the funding for the Advanced Technology Project to promote industry's development of high-risk, high payoff commercial technologies. ATP explicitly abandons the outdated emphasis on spinoffs and focuses directly on the objective of economic growth.
- initiated a network of manufacturing extension centers across the nation to work with State governments to assist small and medium-sized manufacturers, many of whom are still using 1950's technologies. These centers disseminate to manufacturers information on new technologies and best practices.
- developed an action plan for the National Information Infrastructure. This infrastructure -- computers, computer data banks, fax machines, telephones, video displays -- has as its lifeline a high-speed fiber-optic network capable of transmitting billions of bits of information in a second. The technology is improving at an unprecedented rate, expanding both our imaginations for its use and its effectiveness.
- reinvigorated the technology programs within the National Aeronautics and Space Administration, putting more emphasis on industry technology programs, targeted technology investments, and aeronautics R&D.

While Federal technology programs are important, they cannot succeed without change in other government policies. Many existing fiscal, trade, and regulatory policies stymie rather than encourage investment in new technologies and new products. The Administration intends to change that. Already, with the help of the Congress:

- We've obtained a 3-year extension of the Research and Experimentation (R&E) tax credit, and we're still working to make it permanent. We've also secured a reduced capital gains tax for investments in small businesses.
- We've liberalized export controls on computers, telecommunications, and other technologically sophisticated equipment that will free up 35 billion dollars in high-tech exports.
- We have aggressively pursued bilateral and multilateral trade agreements such as NAFTA, U.S.-Japan, and the Uruguay Round of GATT that will expand access to foreign markets for America's high-tech companies. New inroads with the Pacific economies also hold great promise.

Finally, I will move to the sixth point in our S&T strategy: we are creating opportunities for international cooperation. The squeeze on resources, combined with the inherent nature of some science and technology projects that drives up their cost and complexity, also impels us toward greater internationalization of science and technology projects -- particularly "Big Science," but all of science to some extent. It grows harder and harder for any single nation to justify projects such as mapping the human genome, developing fusion power, exploring space, or rooting out the mysteries of particle physics and the Big Bang. At the same time, financial and political barriers limit any one nation's ability to deal with global-scale problems for which science and technology offer important understanding, such as global climate change or human population growth.

In the space arena, our efforts to expand international cooperation to include Russia as a partner offers an opportunity to increase the capability of the space station and to advance the schedule for on-orbit operations. Working with Japan, Canada, Europe, and Russia, we will be able to accomplish what would be difficult if not impossible for one country to do alone.

Overall, we require better mechanisms for multinational planning and cooperative decision-making and action. Building on the ongoing work of the Megascience Forum at the Organization for Economic Cooperation and Development, we intend to explore efforts in joint planning and implementation for one-of-a-kind research facilities, creation of more formal international networks and consortia in selected fields -- capable of negotiating agreed divisions of labor -- and development of more multinational research institutions.

Internationalizing scientific endeavors simultaneously benefits and complicates things. The personal relationships built by scientists and engineers contribute greatly to international understanding. Cooperative efforts often yield larger results than the sum of individual efforts. Internationalizing science holds great promise for decreasing the huge economic disparities that exist among Nations. Yet issues of who pays, who participates, and location, among others, can be so difficult to resolve that the ill will threatens accords outside the S&T arena. There is an inherent tension between scientific cooperation and economic competition as science grows ever closer to economic performance. Improving our ability to manage such complexities, including the ability to make decade-length commitments of resources, will be an important focus of the National Science and Technology Council.

OSTP FY '93 Accomplishments

During FY 1993, OSTP reorganized to incorporate President Clinton's mandate to: 1) redirect the Federal effort in science and technology toward national goals; and 2) streamline White House operations. A Senate-confirmed Associate Director heads each of OSTP's four divisions. The **Technology Division** also includes an Assistant Director for Technology and provides the administrative base for an Assistant Director for Aeronautics and Space who draws upon the resources of each Division to help fulfill his responsibilities. The **Science Division** includes an Assistant Director for Health and Life Sciences, an Assistant Director for Physical Sciences and Engineering, and an Assistant Director for Social and Behavioral Sciences. The **Environment Division** has an Assistant Director for Environment, and the **National Security and International Affairs Division** has an Assistant Director for

International Affairs and an Assistant Director for National Security. Each division has a small, multidisciplinary staff, and cross-cutting issues are managed in matrix fashion.

OSTP's Director testified before Congress over twice a month in 1993. The Director and staff also played key roles in screening, recruiting, and interviewing candidates for subcabinet posts in Departments and Agencies with responsibilities for science and technology programs.

During its first months in action, the "new" OSTP led White House efforts on several issues of critical national and international concern, including:

Implementing the Technology Initiatives

OSTP, working closely with the National Economic Council, produced, for the President and the Vice President, one of the seminal documents of the Clinton Administration: Technology for America's Economic Growth: A New Direction to Build Economic Strength. This document heralds a new era of cooperation between the public and private sectors in achieving national goals and clearly evinces our intention to use the Federal investment in science and technology to further those goals. We have established interagency efforts to address issues of major concern, such as: defense reinvestment and conversion; patient capital and technology financing; Federal support for manufacturing research; technology for education and training; government infrastructure; space and aeronautics; partnerships between the National Laboratories and industry; and basic sciences.

One early success story in the technology plan is the Information Infrastructure Task Force (IITF), which is charged with forging the Administration's policy on telecommunications and information. The task force developed an integrated federal policy framework to support a plan for a national information infrastructure. This plan will promote private research and investment in a system capable of vastly improving the way information is communicated, stored, and processed in the United States. In 1993, the plan led to improvements in: 1) management of the radio frequency spectrum; 2) the framework for protecting intellectual property; 3) access to government information; and 4) coordination of Federal, State, and local regulatory activities.

OSTP, working closely with the Department of Commerce and other agencies, has spearheaded an effort to establish a new cooperative relationship with the automobile industry. Specifically, a major initiative was undertaken early in the Administration's tenure to develop an understanding with car manufacturers and related businesses that would enable joint pursuit of long-term research and development programs leading to a "clean car" -- one that would provide the amenities we enjoy, such as comfort, safety, and performance, and produce little or no pollution. In September 1993, the President signed an agreement with the CEO's of the Big 3 automakers to jointly pursue a research agenda for a car 3-times as fuel efficient as today's that can help eliminate pollution and ease dependence on foreign oil imports while capturing markets for environmentally sound technologies here and abroad.

Defense Conversion

OSTP helped launch the Technology Reinvestment Project (TRP) to stimulate the public and private sector transition from defense to dual use technologies that have both military and civilian applications. The TRP is an integrated effort by 6 government agencies. The Federal Government received TRP proposals from teams representing more than 12,000 companies, universities and local governments. Significantly, proposals totaling over $8.5 billion in matching private funds were received in competition for a relatively modest federal investment of $470 million.

Coordinating Administration Space and Aeronautics Policy

OSTP plays a lead role in coordinating aeronautics and space policy within the Administration. In the aeronautics area, we are working with the NEC to develop a clear set of national goals and priorities to guide the Administration's investments in research, development, and manufacturing technologies. Throughout this process, we have worked closely with industry to full understand the needs and challenges the U.S. aerospace industry faces through this decade and beyond.

During 1993, OSTP assumed the functions and responsibilities of the National Space Council, and the agency continues to be the focal point for policy guidance and coordination in the White House on major programs and issues important to NASA. Chief among these are a continued emphasis on successful implementation of the space station program, a strong commitment to advancing the Mission to Planet Earth program, sustained support for a balanced science program, development of a national space launch investment strategy, and support for needed management and organizational reforms within NASA.

Integrating Science and Technology with Environmental Policy

OSTP has made significant scientific and technical inputs to a number of key environmental actions. These include the President's Earth Day speech on the stabilization of greenhouse gas emissions; the development of the U.S. National Action Plan for greenhouse gas emissions; and the Northwest forest action plan. In addition, OSTP is playing a leadership role in the development of the 1994 World Meteorological Organization/United Nations Environment Program (WMO/UNEP) international ozone assessment, the 1994 WMO/UNEP Intergovernmental Panel on Climate Change (IPCC) assessments, and the 1994 UNEP Global Biodiversity assessment.

OSTP has also established a senior-level interagency committee to provide an integrated science-technology-economics-policy interface. The committee is co-chaired by OSTP, the Office of Environmental Policy, and the Council of Economic Advisors and will function as a bridge between science and policy by developing integrated assessments of key environmental issues.

OSTP is committed to providing the leadership needed to revitalize the space programs essential to global climate change research. OSTP established an interface to NASA's Earth Observing System Data Information System (EOSDIS) and also provided support toward organization of a National Academy of Science panel on EOSDIS and assisted in writing the charge to Academy members and suggested that a Blue Ribbon panel be appointed to emphasize the importance of this issue.

The devastating floods along the Mississippi River and its tributaries generated a major effort by OSTP to insert environmental science and technology into post-flood plans to reclaim the flooded lands and reestablish the flood control systems. OSTP worked closely with OMB, the Office of Environmental Policy, and many Executive Branch agencies to ensure the Federal Government's rapid, compassionate responses did not unnecessarily foreclose any long-term options for wise management of the damaged areas. An interagency Scientific Assessment and Strategy Team was established to examine the scientific issues associated with short- and long-term flood recovery and to develop criteria for policy and funding priorities.

OSTP worked with other federal agencies to establish the Electric and Magnetic Fields Interagency Committee which was mandated by the Comprehensive National Energy Policy Act of 1992. After review of the legislation OSTP worked with the appropriate agencies to assign representatives and outline the committee program and products. Co-chairs from the Department of Energy and the National Institute of Environmental Health and Safety were subsequently selected to carry out the mandated program as charged.

Enhancing National Security

With regard to national security, we are providing S&T advice in areas of priority concern to the President. Because of the breakup of the Soviet Union and the risk of economic and political instability in the region, as well as the global diffusion of weapons of mass destruction-related technology, there are more opportunities now for nuclear materials, nuclear expertise, technology or actual weapons to end up in the wrong hands. Contributing to: 1) the strengthening of nonproliferation and arms control regimes; and 2) the development of counterproliferation capabilities, is a top priority of OSTP.

OSTP is an active participant in the executive branch review of US nonproliferation and counterproliferation programs established by the FY 1994 Defense Authorization Act. The purpose of this review is to ensure the development and deployment of capabilities and technologies needed to prevent and counter proliferation of weapons of mass destruction.

OSTP has also taken a leading role in addressing the critical problem of the worldwide accumulation of excess plutonium. Our initial focus has been on reducing the danger that some of the plutonium being released by the dismantlement of surplus, former Soviet warheads--and also still being separated at Russia's three reprocessing plants--might be diverted to the black market. We have worked with the interagency Nunn-Lugar program to help strengthen Russia's controls over its stocks of weapons-useable fissile materials. We have also worked with the Vice President's office and the Department of Energy to launch the program announced by the Secretary of Energy to shut down the remaining three operating Russian military plutonium-production reactors by helping to provide alternative sources of heat and electricity to the neighboring populations.

OSTP also helped develop the basis for the agreements reached at the Clinton-Yeltsin January summit, at which the two Presidents agreed to establish working groups on placing Russian and U.S. civilian and surplus weapons fissile-materials under IAEA Safeguards, make Russian and U.S. warhead-reduction activities more transparent and irreversible, prevent the accumulation of excess stocks of civilian plutonium, and study the long-term disposition of plutonium. We are now working through the interagency process to develop a follow-through strategy for these agreements.

Promoting International Cooperation in Science and Technology

OSTP leads the White House effort to coordinate Federal support -- from the Department of State and a cluster of 20 technical agencies -- for international cooperation in science and technology. As part of this effort, OSTP has developed bilateral science and technology agreements. OSTP has actively participated in recent negotiations with Canada, Australia, the European Community and many of its members states, including Germany, France, and Italy. It successfully led the U.S. effort to conclude negotiations with Japan to renew for five years the key U.S.-Japan Science and Technology Agreement. Under OSTP leadership, model annexes on intellectual property rights were developed for S&T agreements, since adequate protection of such rights remain the most visible obstacles to concluding S&T agreements with our major partners.

OSTP led successful negotiations for a new Science and Technology Agreement with Russia to promote bilateral S&T cooperation and support Russian reform process. Vice President Gore and Russian Prime Minister Chernomyrdin signed the new US-Russia S&T Agreement during their December meeting in Moscow, providing a new framework for S&T cooperation in the two countries. The agreement defines overall responsibility and procedures under which cooperative S&T activities will be supported, and provides for the full protection of any intellectual property that results from cooperative programs. The final agreement on the treatment of intellectual property represents an important advance in the bilateral relationship between the United States and Russia, and paves the way for cooperative activities not only in the areas of science and technology, but in virtually all fields of cooperation.

During the December meeting with Prime Minister Chernomyrdin, the Vice President proposed a joint study on strategies for shutting down the two remaining Russian military plutonium-production reactors still operating at Tomsk. These two reactors and a third near Krasnoyarsk are still operating -- nominally because they provide heat and electric power to the nearby populations. OSTP is coordinating White House response and providing technical analysis for the study.

OSTP led U.S. efforts to promote international collaboration in large science programs through the OECD Megascience Forum. The OECD Megascience Forum in 1993 addressed issues in international collaboration, including means of improving coordination among nations, in the areas of astronomy, oceanic and continental deep drilling, global change research and oceanography. The U.S. hosted the experts meeting on global change research, and was a leader in discussions on deep drilling and oceanography. OSTP led the U.S. delegation to each of the Forum meetings.

Also within the OECD, OSTP led U.S. efforts in drafting a report by the Group of National Experts on Biotechnology Safety (GNE) on biofertilizers, plants, and food safety. GNE activities are the primary forum for international harmonization of biotechnology regulations. In the area of trade, OSTP has provided significant input to policy discussions concerning R&D subsidies and GATT negotiations.

OSTP implemented a review of U.S. Policy Toward Fusion Energy and the International Thermonuclear Experimental Reactor (ITER). The review included examination of the status of fusion technology, the site selection process for ITER, and the economic viability of fusion energy. This effort initiated the process of developing a recommendation for the President on the future of U.S. support for international fusion energy research programs.

Sustaining World Leadership in the Sciences

OSTP co-sponsored a forum in January 1994 to consider the future of science in the national interest. The purpose of the meeting was to address the Administration's goal of maintaining world leadership in basic science, mathematics, and engineering. The forum was co-sponsored by 15 other organizations including NIH, NSF, and other governmental agencies, the AAAS and other professional societies, the National Academy of Sciences, and foundations. It is our intent to use the ideas that were discussed during the forum to guide the development of a national strategy for science and science education.

During 1993, OSTP worked with the scientific community and the government science agencies on a number of issues of national importance, including the B-factory, support of the Tevatron, the Advanced Nuclear Source, and other physical sciences initiatives. OSTP has also coordinated an interagency approach to merit-based support of research in universities located in states with small per capita federal funding of R&D. This has been predominantly through the Experimental Programs to Stimulate Competitive Research An OSTP report on the issue has been influential in developing this response to the sense of regional inequity that contributes to the problem of earmarking research funds.

OSTP Budget Request

OSTP's budget request of $5 million for FY 1995 will enable the agency to fulfill its responsibilities in a White House committed to using science and technology to enhance economic, environmental, and national security. The Director, the 4 Associate Directors, and a staff of 41 highly trained and experienced professionals (including 6 detailees) will continue to carry out the merged staff functions of OSTP, the National Space Council, and the National Critical Materials Council. In addition, OSTP will support the activities of the new National Science and Technology Council and the President's Committee of Advisors on Science and Technology. Growth in personnel and travel costs primarily account for the requested budget increase.

Mr. Chairman, OSTP has an essential role to play in enabling the American people to use science and technology to create and sustain the kind of future they yearn to secure for themselves and for their children. Citizens of this Nation want a growing economy with more high-skill, high-wage jobs; a cleaner environment where energy efficiency and innovative industrial processes enabled by technological ingenuity increase profits, conserve the natural resource base, and reduce pollution; a stronger, more competitive private sector able to maintain leadership in critical world markets; an educational system where every student is challenged to reach his or her full potential; national security reflecting a world that has been made safe for diversity; and an inspired scientific and technological research community focused on ensuring not just our national security but on increasing our intellectual capital and improving our quality of life. Science and technology are absolutely key to reaching those goals.

I ask for your support for OSTP's Fiscal Year 1995 budget request. I would be happy to answer questions now.

SPACE STATION COSTS

Mr. STOKES. Let me begin with a question about space policy. Over the last year, OSTP has been very involved in space policy within the Administration. Recently we have begun to hear concerns that the total cost of the space station programs are increasing perhaps another $1 billion, and the schedule will continue to slip programs another six months. There are also some very serious questions about power not having been resolved.

Can you comment on any of this for us? Have you heard anything with reference to the total cost of the space station program increasing?

Mr. GIBBONS. Mr. Chairman, I would like to make just a brief response to you and then ask, if I may, Mr. Johns, who is in charge of this activity for OSTP, to follow up and be fully responsive to your question.

Mr. STOKES. Sure.

Mr. GIBBONS. You know where we started a year ago. It was a program that was about to eat up all of NASA's resources if someone looked realistically at the outyears of station. So we undertook a redesign, an attempt to downscale and yet at the same time hold on to the critical parameters, such as power as you just mentioned.

That went on during the spring and we arrived at a transformed and downscaled version of the station called Alpha, I guess it was around April–May of 1993. At about the same time it became clear that there were some very interesting possibilities to expand this international partnership to include Russia as well as the other nations, Japan, Canada, and Europe.

Then we spent the summer looking and the fall looking at what might happen if the partnership were expanded and we took on those additional assets that the Russians might have to offer.

There will be two meetings in Houston within this week to look at the early Alpha design. I believe it was about $19 billion, although Skip Johns knows better, and it now looks like we can do it at $17 billion, a lower number rather than a higher number, but it is conditioned very strongly on a couple of things.

One is whether or not the Russians come in and enable us to get on orbit faster by virtue of some of the technologies they have in hand and are willing in part to sell and in part to offer as part of a partnership.

So it is important. The Russians could be shortening the time for us to get on orbit, meaning that we can cut the outyear costs. It depends very strongly on whether we can keep up the schedule.

The savings we calculate on this thing are strongly dependent on the schedule. If the schedule slips, the savings slip away, too. And I think we can give you some more definitive information on this after we have a program review at Houston, where we have now centered this activity, when we resolve the work with the Boeing Corporation, which has been chosen as prime contractor, and after the members of the external review committee, chaired by president Chuck Vest of MIT, finish their deliberations later on this week.

May I ask Skip if he could add to that?

Mr. STOKES. Certainly.

Mr. JOHNS. The number is $17.4 billion—that is reasonably close. We don't see a budget slip, what we see is a firming up of the delivery date.

The earlier time line was one that was very tentative and what we were shooting for. As Dr. Gibbons indicates, we have a design review coming up this week. Similarly, we don't see $1 billion slippage with regard to the budget at this time.

One hears that we are a distance apart with regard to the negotiations with Boeing. This is a major contract that is in the process of budget negotiation, and Boeing is naturally not coming in to low ball the contract. We have to sort out the details of that contract, and we expect that the contract will be in line with our budget.

Mr. STOKES. What about the schedule slippage?

Mr. JOHNS. I don't believe that there is a slippage. I think the earlier date was a date that people were talking about, but it was not a date that we were committed to. So I don't think there is a slippage there. We certainly have to fight against slippage because as Dr. Gibbons indicated, slippage costs us the money savings that we are seeking to reap.

Mr. STOKES. How about the power issue, Dr. Gibbons? Have those questions been resolved?

Mr. GIBBONS. The questions have not been fully resolved I think because, for example, all of the participating nations with the exception of Japan have been trying to adjust their participation in the face of a uniform illness, namely a shortage of funds.

For example, I believe the European module is still under some uncertainty of exactly what kinds of experiments they will be bringing on board. The Japanese are holding more still than any of the rest in this regard, but I think the, Skip, you might summarize where the power situation is.

SPACE STATION POWER SOURCE

Mr. JOHNS. Basically we are seeking to choose the power competitively. That process is still underway, and negotiations with regard to the Russian contribution and American contribution are subject to that competitive process. We don't see a power problem.

Mr. GIBBONS. One of the discussions with the Russians, for example, Mr. Chairman, centers not only on the conventional photoelectric power sources, but on advanced methods the Russians have developed. A major American corporation is working with them now for solar power trapping using essentially a collector, boiler, and a turbine which could considerably increase the amount of power available.

That is still like the schedule. It is in the process of being shaken down now into a harder and harder set of numbers. I am sorry I can't be more definitive for you now, but it is my impression that all of these numbers are coming together now with this design review this week. This spring these numbers are really now finally taking the kind of firmness that we need in order to be able to move ahead.

Mr. JOHNS. And we will be reporting back to you on the 2nd of April as a result of this design review, so you will be absolutely current.

OVERSIGHT OF SPACE STATION

Mr. STOKES. Dr. Gibbons, do you have somebody at OSTP that tracks issues such as total cost schedule, power, things of that sort?

Mr. GIBBONS. Mr. Johns as Associate Director for Technology with respect to overall NASA activities and particularly with respect to station, is in day-to-day contact with NASA and with the Administrator. And Mr. Richard Dalbello, who is not with us today. I had to leave somebody in the shop.

Mr. JOHNS. He is in Houston actually.

Mr. GIBBONS. He is in Houston today. Mr. Dalbello spends his total time on tracking the NASA situation. We feel that there arrangements and the kind of external expert advice that we can get through Dr. Vest and others gives us a rather good handle on what is happening there.

Of course we can't be OMB or GAO in terms of high detail examinations, but we work very closely with OMB in all of this oversight.

Mr. STOKES. Let me ask you this in light of current thoughts that NASA's budget can't be increased in future years. If we have increased costs relative to the space station, do you envision a time in the future where the decision to build a space station will have to be revisited, in order to keep the station from being like Pacman; just eating up other NASA programs?

Mr. GIBBONS. One of the first things we did, Mr. Chairman, you may recall, was to put a cap on station expenses and a firm cap that the administration fully well understands. So having a cap on that piece of NASA assures that it is not going to come out and eat the rest of NASA. It has to stay within that cap.

That is our commitment, and we believe that will be the case, and that in fact within that cap, the station can be constructed.

Now, of course we have to be concerned about the future. It is always those things that you don't think about that sneak up on you. If something happens in our international partnership, that changes that situation. For instance, the Canadians had a difficult time a few weeks ago in deciding to maintain their commitment to the arm for the station. So what we are trying to do within this cap is to have enough resiliency to change, to be able to handle these things. And we believe that is the case.

Mr. STOKES. This year, the subcommittee is going to have to make some very tough budget choices. We do not know what our 602(b) allocations are going to be. We have not in recent years had a 602(b) allocation that matches the President's budget request.

There is roughly a $3 billion difference between CBO and OMB in terms of outlays. We are going to have to make some very tough choices. If decreases have to be made in the 1995 NASA budget, where would you suggest such reductions come from? Station? Shuttle? Aeronautics research? Space science? Can you give us some direction?

Mr. GIBBONS. I would prefer to give it more thought than I can at this very moment, but let me give you a few comments and programs. I could follow up with a communication with you in the days to come.

Mr. STOKES. Sure.

Mr. GIBBONS. First of all, NASA has been squeezed as you know in the 1995 appropriation request. We have already put a lot of pressure on holding that agency's budget in fact in very tight rein.

And putting the cap on station has further tightened that system. They have to design to a number now rather than design and then find the number. Third, we have been able to preserve, Mr. Chairman, our space science work. We are able to move ahead in our work in aeronautics which is a very important thing for the American economy.

The shuttle is an investment that has been out there for a long time and something you can't just suddenly turn around without major losses. So I think what has happened to start with is that NASA's budget has already been squeezed about as far as we feel we can squeeze and still keep programs viable.

If you think for instance, Mr. Chairman, about the station, now, say compared to the station a year ago—first of all, it is at lower cost. Secondly, and I think very importantly, the station is the very tangible evidence of the changed world that we now find ourselves in. A station that had been designed and presented as a way of sort to countervail against the Russian threat—you remember those old television ads about here goes the ominous Russian station, so we have to have ours now—is now a partnership. We are co-venturing across several nations to put our collective technological talents to work in something that is very visibly oriented toward a world that is peaceful. We are working together on issues rather than spending money fighting each other.

I think the symbolism and importance of the station has really been transformed in the past year and that also transforms our feeling about its priority.

DEALING WITH THE BUDGET SQUEEZE

Mr. STOKES. From discussions with OSTP and the White House, the 1994 process guided reductions that had to be taken, away from NSF and toward NASA. The 1995 budget seems to follow along that same path. There is an increase for NSF and a decrease for NASA.

Would your priorities change, that is protecting NSF, if reductions have to be made in the 1995 request. I think we recognize that decision might be more difficult because in 1995, NASA's request more tighter.

Mr. GIBBONS. Yes, sir. I understand that is a particularly difficult thing for your committee because it is all within the same piece of 602(b). Our concern about fundamental research is that among industrial nations, the amount of resources we put as a Nation into fundamental research is significantly lower in terms of percent of our GDP or however you want to measure it than the other industrial nations.

That is why we feel it is paramount to give the support to fundamental science. So if I had to rank a priority for you, I would rather see what I can do again in terms of—Dan Goldin will kill me for this, I would rather look harder at NASA than to try to find the funds in NSF to cover that.

But I would have to look at those both very carefully with you, Mr. Chairman, to give you a full and reasoned response to that.

The dilemma is it pits fundamental science against space programs of great national and international importance in our technology.

Mr. STOKES. It would be helpful to us by giving us your reasoned thoughts regarding this matter after you have had a little time to think about.

Mr. GIBBONS. I would be happy to get back to you on that if you like.

Thank you.

Mr. STOKES. Mr. Lewis, I yield to you.

Mr. LEWIS. Thank you, Mr. Chairman.

Dr. Gibbons, it is good to see you.

Mr. GIBBONS. Thank you.

QUESTIONS FROM MR. LEWIS

I find myself wanting to dwell on the Chairman's questions for a moment.

Last year was the first year that Chairman Stokes and I had the rather stimulating experience of working together. The President and the Vice President had put pretty high stakes on NASA's budget and the symbol of station. Mr. Stokes before he was Chairman, had taken some pretty strong positions relative to space station, even though a portion of that work is done adjacent to his district.

Nonetheless because of the President's priority, and significant loyalty to this administration, he was willing to look again.

And when Lou asks about priorities within NASA and within the science community, I don't believe he is asking them lightly. To see any reversal of that public commitment and effort from last year to this year would be, I think, a serious disservice to this Chairman.

I am also supportive of NSF, but their budget has moved up in the last decade a little bit over 150 percent. That is significant movement. The NASA budget in turn has been squeezed, as you know.

Chairman George Brown has said publicly on several occasions that if there is not priority given by the administration to NASA's budget that allows station to go forward and at the same time have important scientific projects go forward, he can not be taken for granted.

If that should occur, that puts my Chairman in a very, very difficult position, so some very tough administration politicking has to be done here. I don't think George Brown wants to do that, but I think he is serious about it. If he takes that position, that puts my Chairman in a very difficult position.

And I think it is awfully important that message go back downtown. Far be it from me to give political advice to the President. He has got lots of advisors these days, but one of the things that he doesn't need is the public essentially getting a message that this President walked away from our role in space. And I can see that happening this year unless there is a very strong statement made earlier.

ADMINISTRATION SUPPORT FOR SPACE STATION

Mr. GIBBONS. I appreciate your comment, and I want to reiterate that this administration strongly supports the station, if anything, much more strongly now than it was able to a year ago. Developments have occurred that put this four square in the middle of our leadership of the new post–Cold War world in terms of technology and our demonstrated capability to lead in large international ventures.

A lot of other things follow from this, and we have fenced the funds for station so that station is able to plan on a $2.1, I think that is the right one, $2.1 billion per year commitment.

At the same time we are determined to go as carefully as we can in cost sharing with international participation and with reorganizing within NASA. As you know, NASA is in the process of transforming itself in order to be able to do things like station more effectively. We have established a single center site for the operations, that is at Houston. We have established a single prime contractor. These were the strong recommendations given by the external advisory committee. We feel like we are moving quite clearly in the right direction on this thing, and I appreciate your concern and especially of this committee where one is in a sense forced to try to trade off the science against science rather than trying to think about science as a fraction, as a less than 3 percent fraction of our whole national budget.

And we aim to work very hard with you on this issue. But I can reassure you in every way of the continued commitment of the Administration to the station. If anything it is intensified by this opportunity to use it as a vehicle in our work with Russia as well as the rest of the world.

If you think about our progress, for example, in the missile control regime, in working with the Russians in shutting down their plutonium producing reactors, and all of these other things, they are all related to our engagement with them in the space program as well.

Mr. LEWIS. I think all of those items are very, very important to the credibility of the Administration.

A lot is at stake in this including our ability to lead in the international marketplace. NSF received the largest percentage increase in the budget allocation for this subcommittee. They are all relative dollars of course. Veterans actually got the largest number of dollars in terms of increase and that is not unusual in our committee. I sure hope the Administration understands this subcommittee. I don't think this subcommittee in Majority form is going to go easily to take money away from housing or from veterans or otherwise for a category called NASA.

The 602(b) comes down a little differently than that. But strange things have happened when we cross those lines in committee. So it is very important that OSTP be exercising their advisory as well as their persuasion capability within circles so the priority gets upstairs as Chairman Brown is looking at it. I think my Chairman is in a difficult position here and doesn't want to be in that position.

I want to help him all that I can and station is obviously a bias of mine, but we are right at the crunch and the Chairman is not asking the question about just this year. It is a commitment that goes beyond this year.

CONSIDERING PRESENT AND OUT-YEAR COSTS

Mr. GIBBONS. That is right. I think we have to get in the habit of thinking about outyear programs, the outyear costs as well as the present costs of these long-term programs.

And Mr. Chairman, I certainly pledge any help that I can give you in this regard, in trying to underscore the reasons why we feel these programs are such essential investments in our future. We have to be careful in trading off consumption versus investment, borrowing versus fund raising, and this is at the very heart of it. We feel that both the NASA and the NSF are very important facets of our national investment strategy.

Mr. LEWIS. I know your shop had to absorb activities like the White House Space Council and Critical Materials Council which existed previously in separate operations. Your justification contains a line item for consulting services, that is a minor item constituting about $40,000.

Your fiscal year 1995 budget would support no more than a total of 41 employees including you and your four associate directors and six detailees from other Federal agencies. Are these numbers in the bar graph provided within the second table on your justification accurate and a total reflection of resources and staff available to OSTP?

OSTP STAFFING

Mr. GIBBONS. Yes, sir. Let me just summarize, then I will ask Barbara Ferguson to give you more specifics.

We have a staff including myself and my associate directors of 40 staffers plus up to six detailees, half of the salary of which must be reimbursed by OSTP to the lending agencies. Those numbers are lower than obtained during the previous administration, reflecting the President's commitment for us to tighten down our own ship before we tighten down that of others, and we are maintaining that commitment of 40 plus six detailees.

Mr. LEWIS. Okay.

Mr. GIBBONS. May I ask Barbara, do you have that? He asked a specific question.

Mr. LEWIS. I think I asked you whether that reflected the total. I think the answer was clear.

Ms. FERGUSON. Yes.

CRITICAL TECHNOLOGIES INSTITUTE

Mr. LEWIS. The reason I was probing that a little is an item—the Critical Technologies Institute—that exists primarily for the purpose of providing analytical support for OSTP. Its funding of $2 million comes from within the budget of the National Science Foundation.

Mr. GIBBONS. That is correct.

Mr. LEWIS. Which Federal agency in the operating committee for CTI actually oversees the contract with Rand for CTI?

Mr. GIBBONS. De facto at this point, in terms of CTI, it is OSTP that is the dominant oversight of that activity. I am just in the process of organizing some work to increase the extent of our oversight and the utilization of those resources by ourselves and by the NSTC as well.

Mr. LEWIS. Do you have any idea how many CTI personnel are devoted primarily to OSTP?

Mr. JOHNS. CTI employs 16 full-time equivalents.

Mr. GIBBONS. Sixteen equivalent people.

Mr. LEWIS. What are the top two or three research priorities which will be undertaken by CTI in 1995?

Mr. GIBBONS. Do you want to respond to that?

Mr. JOHNS. They have been working on what we have been trying to establish, R&D priorities in a strategic sense to provide guidance to OMB and to the agencies and in order to do that, we have been working to get a database that represents the entire Federal R&D budget so that it could be crosscut by the new committees of the NSTC and budget strategic guidance provided. This has taken a substantial portion of the discretionary base.

In addition, the CTI has worked on some problems in national security, some areas with regard to critical materials and to critical technologies. They have sponsored a series of workshops that were information gathering workshops to aid in the policy-making process at OSTP.

They have been doing that in cooperation with us. They have been shifting the base of their technical resources in order to better serve our science side in addition to the technology side by in effect mixing the base that they draw from engineers to more life scientists.

Mr. LEWIS. Skip, I saw you shaking your head a little bit during my early comments. I suggest if there is any of that energy left over among those personnel who can help us all focus on the question I raised about Station, I certainly encourage it.

Mr. JOHNS. The President and Vice President are absolutely committed to the space station and they are going to take whatever steps they can to facilitate the process up here.

Mr. LEWIS. Usually I ring this alarm about three months from now, but this year I think it is different.

Mr. JOHNS. The bells are ringing.

Mr. LEWIS. I direct your attention to the last paragraph on page 5 of the statement. And I quote, "Even without our new institutions fully in place, we are beginning in the United States to overcome the inertia of the situation we inherited over a year ago," unquote.

I have known you for a long time and I must say that I kind of chewed on that language, and I am trying to figure it out. What is this comment about inertia inherited? What are we intending to communicate there?

CHANGING RELATIONS WITH RUSSIA

Mr. GIBBONS. In part I guess because I am beginning to learn my job in that other branch of government, Jerry. In part because we have encountered the reality of the rate at which we were engaging ourselves, for example, with the Russians and their enormous problems in facing their economic conversion and their arrangements for handling their nuclear weapons that were distributed among the former Soviet Union States.

Inertia, in my book, means we simply had not been watching the process as a country. We hadn't been moving aggressively forward and doing something about it. I am pleased, for instance, that OSTP has been participating closely with the National Security Council, State Department, and Department of Defense in moving faster in working with the Russians and the other states of the former Soviet Union.

Another area in which we have gained momentum is defense conversion activities within our own country. We're making more aggressive moves towards having the information resident in our national labs, for example, about pollution controlling technology, make that more readily available to the American industry that is being pushed to put that kind of technology into their system.

I see this as something that was latent during the 1980s and early 1990s, but was not moving with the kind of rapidity that we judge to be fully justified. That is the basis for my sentence.

Mr. LEWIS. You and I know each other pretty well, so I scratched my head. I thought maybe it was a little overzealousness on the part of some staff person who might have put this together. Even without our new institutions fully in place, we are beginning in the United States to overcome the inertia of the situation we inherited just over a year ago.

That sounds almost like some rhetoric I hear about the past 12 years. So I just thought I would raise it. I hoped that you didn't mean it that way.

Mr. GIBBONS. Those words were mine, but they weren't meant in the way that you perceived them. I apologize for that if that is the case. I think I have given you two examples of what we did feel coming into it. Of course, I am finding out working in the Executive Branch, and I have not worked there since 1973, 1974, was it is a different place. Sometimes it feels like you are trying to push wet noodles to get things accomplished.

But I appreciate your comments on this. I have been frustrated, and I am not yet satisfied that the kind of velocity we should be moving in various directions is up to what it ought to be.

Mr. LEWIS. Mr. Chairman, thank you. You have been more than kind.

Mr. STOKES. Thank you. Mr. Torres.

QUESTIONS FROM MR. TORRES

Mr. TORRES. Thank you, Mr. Chairman.

Mr. Gibbons, thank you for being here this morning, sir, and your associates.

I posed this question to the NSF people here during the week, but it was really the wrong place to do it. I asked about you; I thought you might be in the crowd with them. They said, no "He, is coming later."

Mr. Gibbons, as you may know, I am an author of a concurrent resolution currently pending in Congress which expresses the sense of Congress that the President should develop a strategy to bring the United States back into active and full membership in the United Nations Educational, Scientific and Cultural Association, known as UNESCO.

Don't you agree that UNESCO—and I am sure you are cognizant of this organization and what has happened—is a valuable resource that our Nation can use to network on the issues that you have talked about? In our national education, scientific, and cultural communities around the world?

MEMBERSHIP IN UNESCO

Mr. GIBBONS. Mr. Torres, I firmly concur that we have not only strong commitments here at home in terms of enhancing the ability of people to reach their full potential, but we have a role as a partner in UNESCO and in this process around the globe to lift people's individual capabilities to their fullest potential and also those of their society in which they are invested. Therefore I think our attention to and commitment to the United Nations and UNESCO is very, strong and very positive.

I might ask Jane Wales who heads our international division if she would add to that with specificity about exactly what is happening in Paris and our relationship with UNESCO, but I can certainly assure you of our concern about our role as a full partner in North/South development questions. But let Jane——

Mr. TORRES. Before we hear from her, let me ask you: What do you mean by a full partner?

Mr. GIBBONS. A full partner with the other nations of the industrial world in seeing to it that the lessons we have learned in our development are made as fully available to the rest of the so-called southern nations as we can.

For instance, the Vice President just arrived yesterday back from a visit to three countries in South America concerned about the internationalization of the information highway because we simply can't think of these things as a national activity anymore. It is all part of a global activity and as we develop and profit and learn from that experience, we feel it should also be available in its fullest form to other, to our trading partners, which includes both North/South as well as East/West.

Mr. TORRES. I will come back to that.

Ms. WALES. It is hard to be more eloquent than Dr. Gibbons. We are working with the NSC staff to see what the relationship will be with UNESCO. This is one of the things high on the agenda of the international committee of the National Science and Technology Council. I would be happy to work with you on the question.

Mr. TORRES. Thank you. I read your mission statement and it very aptly explains the new era that we are working in and the new global strategics that you need to utilize.

You just cited the Vice President's return trip. You also spoke earlier about the new opportunities in international cooperation. I am talking specifically about science and education and communications and you used the key word: Investment. That we need to make an investment.

And UNESCO is an investment I think that would yield commercial value to us as a Nation. It would yield technological knowledge that we may not have, but we can share, and as you indicated, this will put us on a competitive edge globally to deal with our own commercial needs.

You know by not being in UNESCO, we are not a member of that organization. By not being a member state, we lose a lot. We don't have a process whereby we can bid on procurement contracts. We can't sell American instrumentation. We can't sell American products, we can't sell vehicles, we can't sell printing needs or audio visual needs, or graphics not to speak of jobs.

We don't have jobs at UNESCO. If we have any, they are holdovers from many years ago, but we are not able to promote people to secretarial positions as international civil servants, nor are we able to field consultants to UNESCO because we are not a member state. We don't belong there so we are losing literally mega bucks, millions, billions of dollars because we haven't made the investment to get back into UNESCO.

Mr. GIBBONS. It is true there is a history of our disenfranchisement from UNESCO around some differences about the leadership of that organization, and we have been focused on bilateral and multilateral arrangements that are parallel with UNESCO. I would be pleased to return with a note to you about our situation with respect to UNESCO now and how we see that situation in terms of our present commitments at the United Nations and follow up with a note to you.

Mr. TORRES. I would appreciate the note. But perhaps you could tell me now in advance of a note, have you made any recommendations to the President?

Mr. GIBBONS. I have not made any specific recommendations to the President about this and I have not had a chance to talk with Ambassador Albright about it. We have been deeply engaged with our very limited resources. It is again playing the French battlefield term of triage. We focused on Russia and the former Soviet Union and bilaterals, for example, with China when we will be deeply engaged in April and to that extent, we have simply not been able to get around to the UNESCO issue. However, with your interest, I would be happy to follow up and see if we can't get into that a little deeper.

Mr. TORRES. It is not only my interest. There are a number of Members of Congress who have the same interest and as I said there is a concurrent resolution pending here in Congress relative to that. I hope when you do raise it with the NSC or the President, that it is not as you said just a wet noodle, but really something that is tangible here.

Mr. GIBBONS. Thank you for drawing that to my attention I will follow up.

Mr. TORRES. Mr. Chairman, I have no further questions and I yield back the balance of my time.

INFORMATION SUPERHIGHWAY

Mr. STOKES. Thank you, Mr. Torres.

Dr. Gibbons, I want to refer to your justification at this time. You mention that one early success story in the technology plan is the Information Infrastructure Task Force, the IITF, which is charged with forging Administration policy in telecommunications and information. Then you go on to talk about an integrated Federal policy.

Let me just tell you, when we talk about this superhighway of information and so forth, I have several concerns. First, I guess we are talking about something that is probably so massive that the Federal Government itself is not going to be able to bear the costs alone.

We are talking about reliance, heavy reliance, upon the private sector. In that vein, I am little concerned in terms of certain populations, particularly minority populations, even rural populations, and how they are going to be affected and protected by it.

Has the Administration given any thought to this area?

Mr. GIBBONS. Yes, sir. In fact, we remember well back in President Roosevelt's time in the middle 1930s, the legislation and regulation of the telephone system that was available to all Americans, not just to a subset of our grand Nation. I think we have the same kind of concerns about the regulatory process and public policy, both at Federal and State level, in devising the national information infrastructure.

Skip Jones and I meet regularly with the Vice President about this. This is his area as you know of great concern, and that question constantly comes up as part of our concern that as we move forward with the technology, that it's universal access and availability is guaranteed. We are looking at this not only in terms of the regulatory environment for a changed telecommunication regulatory bill, but also in the way we dedicate our funds to develop ways to use this new infrastructure to the end of public services: Education, health care, libraries, people with more limited means.

How can we make sure that they have access and can take full advantage of this new kind of technology?

In the active working arena, Secretary Ron Brown and Assistant Secretary Larry Irving are both very much concerned about these issues and have I think made major contributions in keeping all of us attuned to this very important social aspect of this.

We also have, as you mentioned, the task force. I think one of the things that is helping with the task force is they are actually visiting areas of southern California and I believe Arizona or New Mexico in rural areas and in areas of the disadvantaged populations to make sure that what we are working on makes sense for the realities of those places.

And finally, the advisory council on the infrastructure is, I think, reflective of our broad concern about the population. For example, the chairman who heads the NPR now his stated concern is the kind of concern you have raised so we feel we have built it into the system. I can tell you personally how deeply committed the Vice President is to just this very point. And as I think you started out on this line of dialogue, the government's role here is not to go out and build or to pay for that system, it is to provide the enabling mechanisms for it to happen with the private sector, through regulatory and other policies. And the government's additional role is to try to figure out how we can ride on that highway in terms of public interest.

As we provide cars that move on it, can we provide assurance of security in that system? Can we provide access and can we provide the kinds of ways at the end of that highway to really use it effectively in the delivery of public services?

MINORITY ACCESS TO INFORMATION TECHNOLOGY

Mr. STOKES. Well, I am pleased to know that the Administration is sensitized to this particular area and is taking steps in order to protect the populations that we are talking about.

Let me take this discussion just a little bit further. Last year you and I had some discussion about minority education and we discussed it in the context of the demographic information we now have relative to the year 2000 and beyond and what the American workplace is going to look like. What I would like to do is just take that discussion of last year a little bit further. I am concerned about how this new information technology will reach the disadvantaged, minority youth, for instance, who are going to be so vitally affected in the year 2000 and beyond.

Recently in the city of Cleveland, ninth graders were tested under new State law in the inner city, and 80 percent of the ninth graders failed math; only 20 percent passed. That is a terrible statistic that you have to deal with.

And this scenario is largely composed of minority youth. So, as we look down the road, we need to talk about the special superhighway and the universal access that it must have if it is really going to have an effect in terms of real information getting out to all Americans.

I am just wondering if the Administration is thinking along these lines as well?

Mr. GIBBONS. Indeed we are, Mr. Chairman. One of the nine committees under the National Science and Technology Council is the Committee on Education and Training. This committee is cochaired by Governor Kunin from the Department of Education and Luther Williams from NSF and by the Deputy Secretary of Labor, and they engage in the whole process. The Department of Defense really expends a lot of money on education and training but had never really been integrated on the civil side of things. We are spending, within OSTP, a lot of attention on two things with respect to technology.

One is: what in our economy is going to affect the requirements for literacy and for workplace competitiveness for our people? What are they going to need to have as their tools in order to be effective players in the workplace?

And the second is: what does technology offer by way of aids or assists or new ways to help move this education process? Some extraordinarily interesting software is now being tested, I think, in a half a dozen States. Some is directly aimed, for instance, at mathematics, where you can use so-called expert systems programming. The software itself calibrates how the student is doing and devises questions and feedback that bring that student along almost as if he or she had an expert tutor. It even feeds back to the teacher with advice, here is what this student needs most.

As we move forward trying to use technology as an aid to that education process, I think that may be one of our greatest hopes. Our most underutilized asset is really marshaling these capabilities of information technology and computers and getting them really working in the classroom. We are working with NSF, Labor, Education, and the Department of Defense in this process. It is an investment in the very most fundamental asset we have, namely our people.

REIMBURSEMENT OF INDIRECT COSTS

Mr. STOKES. Very good, I appreciate that. The Administration has proposed 1994 supplemental appropriations language that would limit 1995 reimbursement of indirect costs to colleges and universities to the amount that the government provided in fiscal year 1994.

We had rather extensive conversation yesterday with the NSF officials and the National Science Board relative to this so-called pause situation. My understanding is that OSTP had played a role in terms of this indirect cost reimbursement.

Mr. GIBBONS. OSTP's role in 1993 was to work with OMB and finish up the work that my predecessor, Allen Bromley and his colleagues had done on a revision of the A–21 circular from OMB which defines and sets out principles for indirect costs reimbursement to grantees and contractors, and which we felt and still feel was a major step forward and in the right direction.

Separate from that now, when the budget came together last fall and the President was trying to fit ten pounds of things into a five-pound bag, we were operating under the premise that everywhere across government we were going to have to really tighten our ship.

And the rationale for this pause was that in the area of indirect costs for a government grantee, just like we are freezing salaries of people in our government-owned and contractor-operated laboratories, that we are doing a variety of things within the agencies, we are downsizing the work force, that the contractors and grantees should also bear some of this same kind of thrust of running as lean a ship as we could.

So it was decided that for this one year, 1995, a pause would be introduced which would in effect freeze the overhead returns to the grantees at a level no higher than the 1994 returns. Excluded from there are institutions that had $10 million or less in grants. It was a threshold for it.

We understand this is an expedient. We hope and pray it is a temporary adjustment. We want to look more carefully at the whole issue of indirect cost returns and overheads. So we have organized a three-agency group consisting of Alice Rivlin, the Deputy Director of OMB, myself, and Laura Tyson, the Chairman of the Council of Economic Advisors, to look at this question of overheads and returns in the pause. We would engage the universities and nonprofits as well as the Federal agencies in a dialogue about what might be done in the future in terms of improving or lowering the costs of administering research. One of the questions we will be asking, for example, is not just what can you do to cut your costs out there, but what can we do as a government that will lower your required costs in administering this work.

So we are trying to see if we can't help close the gap in terms of meeting our caps and also provide an improved A–21 for fiscal year 1996, this is succeeding years savings from this activity. I believe it is $130 million for FY '95.

Mr. STOKES. Could you tell us how much of that amount would come from the National Science Foundation?

Mr. GIBBONS. We think perhaps $40 million, Mr. Chairman, but the number is a little uncertain.

Ms. GREENWOOD. I would be happy to respond.

Mr. STOKES. Providing it for the record would be fine.

[CLERK'S NOTE.—The information is included for the record immediately following the transcript material.]

[Recess.]

Mr. STOKES. Mr. Lewis, I will yield to you.

MINORITY EMPLOYMENT AT OSTP

Mr. LEWIS. I appreciate it.

Dr. Gibbons, last year we discussed minority employment at OSTP. Information supplied for the record indicated that of the 30 staff on board, six were minorities—four black, one Hispanic, one American Indian. Of the four African-Americans, none were above the GS 10 level.

So I have a series of questions in connection with that. How many minorities are currently on the OSTP payroll?

Mr. GIBBONS. Total minority are seven compared to six last year. I am proud of these numbers, and we are working on it. That is about 18 percent if you run the numbers. Five are African-Americans, one Hispanic and one Native American, and we have one at GS 13, one at GS 11, and the rest at GS 12 or below.

Mr. LEWIS. I was going to ask about GS 13 and above. One at GS 13 and one at 11?

Mr. GIBBONS. Right, and of course it is a small staff and it is not all that mobile, but we are working away on this. I might also add that we now have 19 females or 50 percent of our staff are females. I would like while I am at it to summarize for you the work that we have been doing through the year that I am proud of. I am actually pretty happy about it.

Mr. LEWIS. I noted your admonition.

RECRUITMENT OF MINORITIES FOR SUBCABINET POSTS

Mr. GIBBONS. Thank you. I have been doing a lot of work with my staff in recruiting senior people for the Administration to the subcabinet posts related to science and technology. I think if you look across that spectrum now of folks, you find that they really do look like America. It is a significant move in that direction. You see it in our appointments and even more so in the work I am doing with the President and Vice President on the National Science Board appointments and on the President's advisory committee. While I can't tell you the names because they are still in the middle of the process, I can tell you how it works out with respect to diversity.

If you look at the Science Board there are presently—there are 24 members, 23 of the 24 were male a year ago. One Hispanic and one Asian American. There was one opening in 1993 and we recommended to the President and he chose a very distinguished African–American female. Shirley Malcolm you may know who is a scientist.

Mr. STOKES. Yes.

Mr. GIBBONS. For 1994 there are eight vacancies, that is one-third of the roll. The recommendations that I will make to the President with respect to new appointments will be 75 percent women or minorities and 50 percent minorities because we feel it is essential to have the face of America appear in that kind of roster, too.

Mr. LEWIS. Is that in the recommendation process?

Mr. GIBBONS. It is in the White House personnel office now and it is supposed to go to the President. The President has, and I can speak more directly about this one, the President also has now reviewed the recommendations for his committee of advisers on the Science and Technology and that is about 50 percent, almost exactly 50 percent are either women or minorities, and 25 percent are minorities in that committee. And we worked hard at this.

We found superb people. We lost a few because you know there is great competition for our best people in service in government. But I am pleased we have been able to begin to make that kind of change in the face of some of our large advisory committees.

Mr. LEWIS. I know of your concern, Jack, so I don't feel uncomfortable pushing you a bit, but I would like to see that continued effort over time. The record from last year also indicates that none of the five detailees were minorities. Is there any shift there, do you know?

Mr. GIBBONS. Let me think.

Ms. FERGUSON. We have several of Hispanic origin that are detailees.

Mr. LEWIS. Several are Hispanic.

Ms. FERGUSON. I have one on an IPA that we use in lieu of a detailee who is another individual.

AFRICAN-AMERICAN EMPLOYMENT AT OSTP

Mr. LEWIS. Are there any African–Americans?

Ms. FERGUSON. No.

Mr. LEWIS. Okay. What is the highest grade that is held by an African–American in OSTP presently, do you know?

Ms. FERGUSON. It is a GS 10. That is of our FTEs.

Mr. LEWIS. What is OSTP doing to increase the number and grade of African–American specifically? I am interested in Hispanics as well. I would like to have you detail it more for the record, though.

Mr. GIBBONS. We would be happy to detail it for the record, Mr. Lewis. We need to do more active recruiting. Of course there are very few openings, and people who are permanent employees and the like, as those openings occur, we are going to do a harder job in the future.

We have worked and looked and asked around as we normally do in trying to find people who will fill key positions. But, I realize that we just have to work even harder.

I was so focused on these advisory panels and keyboards that I wasn't focusing as much as I think I should on our own staff.

[CLERK'S NOTE.—The information is included for the record immediately following the transcript material.]

Mr. LEWIS. It is possible I will ask this again next year. If you would update those tables on 360 and 361 for the record as well.

Mr. GIBBONS. I would be happy to do so.

[The information follows:]

THIS CHART REFLECTS CURRENT INFORMATION AS OF MARCH 31, 1994.

POSITION	CURRENT GRADE	CURRENT GENDER	CURRENT ETHNICITY	PROPOSED GRADE	PROPOSED GENDER	PROPOSED ETHNICITY
Director	EX-2	Male	Caucasian	EX-2	Male	Caucasian
Associate Dir. Science	EX-3	Female	Caucasian	EX-3	Female	Caucasian
Associate Dir. Nat'l Sec & Int'l	EX-3	Female	Caucasian	EX-3	Female	Caucasian
Associate Dir. Technology	EX-3	Male	Caucasian	EX-3	Male	Caucasian
Associate Dir. Environment	EX-3	Male	Caucasian	EX-3	Male	Caucasian
Asst. Dir. Environment	SES-3	Male	Caucasian	SES-3	Male	Caucasian
Asst. Dir. Technology	SES-3	Male	Caucasian	SES-3	Male	Caucasian
Special Asst. Def Conversion	SES-3	Female	Caucasian	SES-3	Female	Caucasian
Asst. Dir. Social Sciences	SES-3	Vacant		SES-3	Vacant	
Asst. Dir. Nat'l Security	GS-15	Male	Caucasian	GS-15	Male	Caucasian
Asst. Dir. International	GS-15	Male	Caucasian	GS-15	Male	Caucasian
Senior Policy Anal. Science	GS-15	Female	Caucasian	GS-15	Female	Caucasian
Senior Policy Anal. Technology	GS-15	Male	Caucasian	GS-15	Male	Caucasian
Senior Policy Anal. Environment	GS-15	Female	Caucasian	GS-15	Female	Caucasian
Senior Policy Analyst Env.	GS-15	Female	Hispanic	GS-15	Female	Hispanic
General Counsel	GS-15	Female	Caucasian	GS-15	Female	Caucasian
Asst. to the Director for Intergovernmental Affairs	GS-15	Male	Caucasian	GS-15	Male	Caucasian
Asst to Dir. for External Affairs	GS-15	Vacant		GS-15	Vacant	
Special Asst. to the Director	GS-15	Female	Caucasian	GS-15	Female	Caucasian
Special Asst for Education/Train	IPA	Male	Caucasian	IPA	Male	Caucasian
Administrative Officer	GS-14	Female	Caucasian	GS-15	Female	Caucasian
Information Mgmt. Specialist	GS-13	Male	Native Amer	GS-13	Male	Native Amer
Confidential Asst. to Dir.	GS-12	Male	Caucasian	GS-12	Male	Caucasian
Confidential Asst. Technology	GS-12	Female	Caucasian	GS-12	Female	Caucasian

POSITION	CURRENT GRADE	CURRENT GENDER	CURRENT ETHNICITY	PROPOSED GRADE	PROPOSED GENDER	PROPOSED ETHNICITY
Confidential Secretary to Dir.	GS-11	Female	Hispanic	GS-12	Female	Hispanic
Consultant	GS-11	Male	Caucasian	GS-11	Male	Caucasian
Secretary Environment	GS-10	Female	Black	GS-10	Female	Black
Administrative Operations Asst. International	GS-10	Female	Caucasian	GS-10	Female	Caucasian
Administrative Operations Asst. Technology	GS-10	Female	Black	GS-10	Female	Black
Policy Research Asst. Env.	GS-9	Female	Caucasian	GS-11	Female	Caucasian
Policy Research Asst. Sci.	GS-9	Male	Caucasian	GS-11	Male	Caucasian
Policy Research Asst. PCAST	GS-9	Male	Caucasian	GS-11	Male	Caucasian
Administrative Operations Asst. Science	GS-9	Female	Black	GS-10	Female	Black
Confidential Asst. Nat'l Security & International Affairs	GS-9	Male	Caucasian	GS-12	Male	Caucasian
Administrative Asst. Personnel	GS-8	Female	Caucasian	GS-9	Female	Caucasian
Administrative Asst. Budget	GS-8	Female	Caucasian	GS-9	Female	Caucasian
Correspondence Asst. Dir.	GS-8	Female	Caucasian	GS-8	Female	Caucasian
Secretary PCAST	GS-8	Female	Black	GS-8	Female	Black
Administrative Asst. Records/ FACA/FOIA	GS-7	Vacant		GS-9	Vacant	
Office Automation Asst.	GS-5	Male	Black	GS-6	Male	Black
DETAILEES						
Asst. Dir. Life Sciences	GS-15	Female	Caucasian	GS-15	Female	Caucasian
Senior Policy Analyst Internat'l	GS-15	Vacant		GS-15	Vacant	
Asst. Director Space	SES-1	Male	Caucasian	SES-1	Male	Caucasian
Executive Secy - PCAST	GS-15	Vacant		GS-15	Vacant	
Senior Pol. Anal. Nat'l Security	GS-15	Female	Caucasian	GS-15	Female	Caucasian
Asst. Dir. Physical Sci. & Eng.	GS-15	Female	Caucasian	GS-15	Female	Caucasian

OSTP will take into consideration the Administration's desire for ethnic and gender diversity when filling vacancies at all levels within the office.

Mr. LEWIS. Mr. Chairman, you have been more than generous with your time.

Mr. STOKES. Thank you, very much, Mr. Lewis.

Mr. Thornton, you haven't had a chance to ask any general questions. Would you like to?

QUESTIONS FROM MR. THORNTON

Mr. THORNTON. Yes, sir, I would, Mr. Chairman. Thank you very much.

Mr. Gibbons, Jack, it's great to see you. I want to commend you for the fine job you are doing. I see evidence of it day by day, and I am so pleased that you are here before our committee today.

Mr. GIBBONS. I appreciate that, sir.

Mr. THORNTON. I have two questions which are a combination of general and specific.

The first has to do with the EPSCOR program, which you know is a favorite of mine, and the coordination of that program between the National Science Foundation, where it began, and the other agencies. I understand that interagency coordination has been a matter of concern.

In fact, the Senate FY94 Appropriations language had a requirement for not only NSF to provide a report on cooperative efforts but also that OSTP do so.

Can you tell me how you are progressing on that report of interagency coordination of EPSCOR-type programs?

Mr. GIBBONS. I would be pleased to do so. You and I now are getting to the age where we are not the father of things, we are the grandfather of things.

Mr. THORNTON. That is right.

Mr. GIBBONS. They say children are an inconvenient but necessary route to grandchildren.

Mr. THORNTON. If I had known how much fun grandchildren are, we would have had them first.

EPSCOR

Mr. GIBBONS. But we remain excited about this creature of yours known as EPSCOR. As you know it has worked extraordinarily well within the NSF and other agencies. Now, we have picked up on it and I think are using it very effectively. Although it takes slightly different morphology as you know from Department of Defense to Energy or NSF.

We also know that part of its success is also breeding a problem, namely there are so many of these fully competitive grants being awarded that the necessary matching funds are putting some stresses on some States for making that match. But in a sense that is a sign of the success, not a sign of I think of a weakness or failure.

And we are examining these issues now in an interagency working group on the EPSCOR program. And I think we have negotiated June 10th now as the time to deliver our report to you on this matter. And we will be working, of course, with the existing interagency coordinating committee on EPSCOR that is in place.

That is one of our principal resources for working on this, but we feel this is superb, you would pardon my bragging on you.

Mr. THORNTON. You can go ahead. Be sure we get it on the record.

Mr. GIBBONS. We want to preserve the peer group review process, which goes by quality and originality of ideas, and yet at the same time make this more accessible in an active way. We want to help those States and universities that aren't that deeply engaged in the traditional research to become full partners in the process. We are strongly supportive of it, and we hope that our report will reflect that when we deliver it in June.

Mr. THORNTON. At some point we may want to look again at the requirement for a dollar-for-dollar match on EPSCOR funding research, which is certainly different from the usual research provided by universities where the Federal Government generally covers all of the expenses of the research.

Mr. GIBBONS. I think that is important to look at. I know there are some models. For instance, I believe it is either Energy or Defense that require the matching only for the capital improvements and the like, so I think those bear close examination to see if we can't make the programs more consistent across the agencies and also more realistic about these requirements for matching.

RESEARCH ON HUMAN NUTRITION

Mr. THORNTON. I was late getting to this subcommittee meeting today, Mr. Chairman, because I have made it a point to be at meetings where officers of various agencies engaged human nutrition activities have been testifying. This morning the Assistant Secretary for Agriculture in charge of food stamps and nutrition programs was appearing before another subcommittee, and I wanted to ask her about the research that was being done on human nutrition. My own interest is in early childhood nutrition and even prenatal nutrition which can prevent low birth weight and fetal alcohol syndrome and other very serious consequences to an infant that can become not only destructive to the quality of life for that infant, but also cause a very loaded financial burden to our health care providing system.

I have questioned officials of the Food and Drug Administration, EPA, Department of Agriculture—and I would like to get the National Institutes of Health involved—because I am deeply concerned about the need for coordination of research regarding the health impact of nutrition. I wonder if you share that concern.

Mr. GIBBONS. Indeed we do. In fact, I would like to call on Dr. Greenwood in just a moment to amplify this since her Ph.D. was from Rockefeller University and it involved nutrition studies among other things.

I would make only two points. One, I think you are familiar with the fact that the administration is very much concerned about preventive health care, and nutrition is an anchor of that whole idea. If you take better care of yourself, you are not going to have such large doctor bills down the road, and you are going to live a happier life along with it. So preventive care and nutrition are very much a part of this administration's priorities.

The second thing is that we do understand this is inherently an interagency activity. It includes HHS and other agencies. So we have organized under this National Science and Technology Council a committee that has to do with food, health and——

Ms. GREENWOOD. Health, safety and food.

Mr. GIBBONS. Health, safety and food that Marcy is the White House cochair on. She might be able to describe with you the work there.

Mr. THORNTON. I would very much appreciate hearing some amplification on that work.

Ms. GREENWOOD. Thank you. Jack has made the most important point, which is that there is tremendous interest in coordinating the nutrition effort back across agencies. At the first meeting of the Health, Safety and Food Committee, there was considerable talk about the common agendas that might be developed across the agencies particularly across USDA, FDA, and NIH.

And although the discussions are still in the preliminary stage of how best to do this and how this might be coordinated with an overall agenda related to prevention and long-term health, I am very hopeful that we will be able to get a level of interagency cooperation that would be a substantial improvement over the kinds of cooperations that have been had in the past. We need programs that extend across the lifetime—across lifetime issues including the early childhood and prenatal issues right through aging issues in the area of nutrition.

So I think this committee will be a very good place to start with interagency cooperation, and I hope that by this time next year I can give you a much more specific answer about what it is that is happening in interagency coordination and what the possible initiatives might be.

EPA ADMINISTRATOR

Mr. THORNTON. EPA Administrator Carol Browner has made a very affirmative response from the standpoint of EPA regarding her interest in this kind of study, this kind of program. I am sure that your efforts will include all of the major actors in this effort.

Ms. GREENWOOD. I didn't mean to leave EPA out. EPA is a member of this committee and they have expressed considerable interest in this agenda issue. Yes.

Mr. THORNTON. Can you tell us what we can do to facilitate or encourage this kind of study or program.

Mr. GIBBONS. Well, first of all, I think your support of our moving ahead with the President in establishing the NSTC which brings full Cabinet level attention to these issues and the committees operate under that umbrella is a very important thing.

It takes a lot of our time and attention. And I think the extra resources to really integrate these programs across the Federal agencies is a very high return investment for your return.

Mr. THORNTON. I come from an area of the country where the Delta Commission has identified enormous poverty that affects entire communities. It has a devastating effect on a large African-American population, but it is not limited to any one group, and the impact on rural areas is equally important to me as the impact on the urban areas where neglect and poverty are also a major problem. I am sure that your study will be geographically balanced and take into account all of the problem areas.

Ms. GREENWOOD. It certainly will, yes.

Mr. THORNTON. Well, Mr. Chairman, I just want to express my appreciation again to my good friend for the great work that he is doing. I hope that you will let me know, Jack, any time I can be of help to you in your efforts.

Mr. GIBBONS. We have. And I personally have so much enjoyed working with you through the years. I think in these new directions we will have an even greater opportunity in years to come, and I certainly look forward to it.

Mr. THORNTON. Thank you very much.

I yield back.

PAUSE ON INDIRECT COSTS

Mr. STOKES. Dr. Gibbons, let me go back for a moment to the discussion we were having about the indirect costs. One of the questions we have been concerned with is why the Administration limited the pause only to grants and cannot include contracts, agreements or other financial instruments? It seems to me that this primarily involves NSF and NIH grantees and does not affect awardees of DOD, Energy, or NASA, because they use contracts and not grants.

What we would like to have is a rationale for this decision.

Mr. GIBBONS. Mr. Chairman, I may be mistaken, but I believe that the pause does go to grant—contracts as well as grants. To me, the more exclusive part was it was to universities and nonprofit organizations.

It does not go to those contracts that were derived on as a result of, for instance, competitive bidding to supply work for the Department of Defense from private contractors. But if I am not mistaken, it does apply to grants, grantees, and contractors in the not for profit and university community.

If I am wrong, I would want to—Marcy do you want to add to that?

Ms. GREENWOOD. I need to see the language to be absolutely sure, but I know it applies to DOD university grants, and I believe it refers also to the contracts.

Mr. STOKES. I guess if it is a grant, it is applicable, but if it is a contract, it is not?

Ms. GREENWOOD. I believe it applies to university contracts and grants. I am not sure that it applies to procurement contracts or to competitively bid contracts. Now, it is possible that I am misunderstanding that.

Mr. GIBBONS. We would be happy to check this afternoon about that and get back to you.

[CLERK'S NOTE.—The information is included for the record immediately following the transcript material.]

Mr. STOKES. I think it would be helpful for us if you could clear this up for us.

Mr. GIBBONS. If you could help us with the language you are looking at, that would help me with the process.

Mr. STOKES. Sure. The subcommittee staff can provide you with that.

ACADEMIC RESEARCH FACILITIES

Dr. Gibbons, as I understand, the legislative committee may task OSTP with establishing a multi-agency program to support the modernization of the Nation's academic research facilities.

The NSF has one of the only competitive merit based program around at the present time, but it is rather small compared to estimates of $8 to $10 billion in backlog.

What are your feelings with respect to such an interagency effort?

Mr. GIBBONS. Mr. Chairman, the issue of the university and our research infrastructure is one that simply can't be handled alone by the limited funds available through the National Science Foundation.

The estimates of what is really required to have that infrastructure fully up and competitive with other countries is a number that far exceeds NSF's capability. Therefore in our NSTC committee on fundamental research, I think that will be exactly the place where this analysis will have to occur, namely looking at it from the point of view of all the agencies that have to depend on that infrastructure out there to provide them with the research activities.

What does the whole of the Executive Branch including Energy, Defense NASA, NSF, NIH have to say about this research, the physical infrastructure for research support? That committee cochair is Dr. Greenwood. I would like to ask if she would like to amplify my response to you.

Mr. STOKES. Sure.

Ms. GREENWOOD. I would be happy to do so. The fundamental science committee will look at infrastructure issues. One of the major concerns here is that the structure of science as it is done particularly in universities and some other settings is changing rather dramatically, and there is substantial participation of a number of agencies in projects that are very much related to each other, and presumably would be using similar facilities, including structural facilities as well as equipment and other types of infrastructure support such as computing and other technologies.

One of the problems of developing an infrastructure support program related to a specific agency is that programs—you don't then get the full view and understanding of how the other agency programs are developing and don't encourage the other agencies who are supporting the fundamental research to take a role in ensuring that the infrastructure necessary to carry that research out is adequately supported.

So, there is certainly an effort and an interest here in developing a strong infrastructure support program, but ensuring that it is broadly understood across the agencies to require multi-participation.

I think another issue here has to do with the very specific issue related to this year's budget situation, the fiscal climate that we find ourselves in and NSF, as I am sure you have heard from them has very strong feelings about investment in the people and in the research as well as investments in the infrastructure and I think the President's budget reflects the very difficult decisions that had to be made in a climate where we couldn't presumably secure the level of support for infrastructure renewal in a single agency that might help that agency, but not necessarily restrict the rest of its program.

CIESN

Mr. STOKES. In fiscal year 1993, Dr. Gibbons, Congress included $2 million for a pass-through grant for CIESN, the Consortium for International Earth Science Network.

The budget seems to indicate those funds were unobligated at the end of 1993. Can you tell us what happened to those funds?

Mr. GIBBONS. As you know, Mr. Chairman, those funds were intended to pass through the OSTP to the CIESN activities. My understanding is that our transfer of these funds to NASA for the CIESN, occurred back in July of 1993. I know that in September, we received a letter from NASA that notified us they had received and accepted the $2 million so that transfer occurred as of September 23rd, 1993.

We effected the transfer back in July and that transfer we did inform the subcommittee staff at that time in late July.

Now, we followed up in March of this year to NASA headquarters and they indicated that the $2 million had been applied to the CIESN activity. In checking with NASA yesterday we are still a little bit uncertain what exactly happened at year end in terms of how those funds were committed, but the transfer from OSTP to NASA occurred in July and in September.

LANDSAT

Mr. STOKES. The 1995 budget request assumes termination of the DOD component of the joint NASA DOD LANDSAT 7 program. The recently enacted Disaster Supplemental Appropriations Act transferred $90 million of 1994 DOD funds for LANDSAT 7 to NASA.

Did OSTP participate in this decision to terminate DOD's component of the LANDSAT 7 program?

Mr. GIBBONS. Well, we were in fact drawn into the LANDSAT issue for a couple of reasons. First of all, you recall that LANDSAT 6 never reached orbit. It was a great disaster because we have two LANDSATs still up there, 4 and 5.

They are between 10 and 12 years old, and they had something like a three year expected lifetime, so they are limping along. We hope and pray they will continue to limp along for a while because it is very important to have continuity of data. At the same time, we have a situation in the increasing constraints of resources and a reexamination of priorities within DOD about where they were going to optimize their resources and they, as a result of that, stated that their priority for LANDSAT in terms of being a full partner in the funding and development of this was not what it had been before. So we had a natural situation for the National Science and Technology Council to get the people from DOD and NASA and NOAA together, those engaged in putting up and operating these kinds of satellites as well as users within the government such as Agriculture, Interior and other agencies, to try to see what would be the most effective way to go from here given the fact that DOD finally wanted to use LANDSAT information, and wanted to remove themselves as full partner.

And through this interagency effort, we did develop a solution which we feel is correct. Namely that the Department of Defense will transfer their present activities in the LANDSAT construction to NASA. NASA will then undertake the responsibility to build that satellite in time to get it up so we have data continuity as well as allow NOAA to become the operating agency for the satellite itself, with DOD then remaining as a user but not as a full partner in this activity.

We believe we have a full consensus on this way to proceed and, within the last couple of weeks, have circulated at the deputy's level a draft of presidential decision memorandum which we hope will be forthcoming very shortly. This memorandum will confirm this is the way to get LANDSAT 7 up and operating with data continuity and service the many governmental requirements for this satellite as well as the private sector and those needs of other State governments, for example.

Mr. STOKES. Was there any concern here that NASA already has more on its plate than it can fund?

Mr. GIBBONS. Well NASA was a partner in this process with DOD and we feel that the transfer to NASA of the full responsibility—of course the thing is relatively well along in terms of the configuration and the construction of the satellite—is the best way to accommodate the changes that have occurred over the past year in terms of DOD's priorities that arose as you know from their Bottoms Up Review.

COMPENSATION FOR DETAILEES

Mr. STOKES. Let me ask you about some language that OSTP is now requesting be carried in the 1995 Appropriations Act.

Back in 1994, the Appropriations Act contained requested language that OSTP reimburse other agencies for not less than one-half of a person compensation cost of individuals detailed.

Mr. GIBBONS. Yes, sir.

Mr. STOKES. This language has been carried across for a number of years. Last November the Administration requested that proviso be eliminated from the 1994 act to permit OSTP to perform its expanded functions more effectively. We did that in the recent enacting of the Disaster Supplemental Appropriations Act. I guess the question is, why are you requesting similar language in the 1995 act.

Mr. GIBBONS. Yes, sir. Well, Mr. Chairman, as you recall, during 1994, the budget for OSTP, I think by lack of full information about where the numbers were coming from was cut pretty heavily on the House side for our 1994 appropriation. To the point that with the assistance of this committee, we suggested that if we could be relieved during that fiscal year of the cost of having to reimburse agencies for at minimum half of the detailee costs that it would enable us to get through the year and survive in this transitional year.

Now, in the course, at the time I faced this issue last fall, I really felt that if we could be permanently relieved of the cost of sending money back to the agencies for the loan of some of their people that would make our lives simpler.

In reflecting further on it and in the reality of our trying to recruit people to fill those roles of detailees, with agencies increasingly under their own stress of support, and in my dialogues with the OMB that has the philosophy that the user ought to pay, I have changed my position on this matter, and I feel that partial reimbursement is probably a very wise management strategy.

Partial reimbursement means it is in the self-interests of that agency to lend someone to us, but it is also in our self-interests to obtain that kind of help. So it enables me to help bring the kind of people in that I am desperately wanting and that I might not be able to do unless I was able to do partial reimbursement, so for 1995 and beyond I am prepared now to say that I think this is a reasonable and defensible user pay philosophy even though it does mean $.5 million that I would love to have someone else pay for, but I think it is appropriate in the budget, Mr. Chairman.

Mr. STOKES. How many unreimbursed detailees are currently on board?

Mr. GIBBONS. The answer is two.

Mr. STOKES. And how many unreimbursed detailee FTEs do you anticipate in 1994?

Mr. GIBBONS. Sort of hard to say except it is getting tougher to get people on reimbursed details, so I would guess if anything that number is going to drop rather than increase.

CONSULTANTS OF OSTP

Mr. STOKES. How many, if any, unpaid consultants are currently on board?

Mr. GIBBONS. You mean unpaid for by OSTP?

Mr. STOKES. Yes.

Mr. GIBBONS. We have a few volunteers, people who come in and help with correspondence and telephones and other things, and we are very grateful for that kind of support that people have been giving us. We have 10 fellows.

Ms. FERGUSON. When you talk consultants, we have three consultants and they are all compensated. We don't have any consultants that are uncompensated.

Mr. GIBBONS. Yes. You were missing "uncompensated by OSTP." That is why I was mentioning things like our fellows. For instance, we have several fellows from the scientific societies who come with their way paid to work in government for a year and that gives us a great deal of help, too.

Mr. STOKES. The justification indicates that part of the increase requested would enable OSTP to fill positions previously left vacant because of budgetary constraints. How many FTEs are we talking about?

Ms. FERGUSON. Well, for FY '94 we have two FTEs that will remaine vacant and then one of the consultant positions will be limited to a certain amount of hours for the year that we can compensate them for. Partial vacancies will equal approximately one FTE.

Mr. STOKES. And what is the current paid employment at OSTP?

Ms. FERGUSON. We have 38. But actually three of those individuals are three consultants that really only equal to one FTE man year worth of effort.

Mr. STOKES. Okay.

Mr. Lewis, anything further?

Mr. LEWIS. Nothing further, Mr. Chairman.

Mr. STOKES. All right.

Dr. Gibbons, that completes and concludes our hearing for this morning. We appreciate very much your appearance and testimony here. I think we had a good hearing.

Mr. GIBBONS. Mr. Chairman, I want to thank you and the committee for the attention you give this little group of folks. We are working our hearts out to try to do what we think is going to be helpful for you, but we also very much appreciate these annual opportunities to go over it with you, and we look forward to working with you in the coming years. It is not going to be an easy year.

Mr. STOKES. Thank you very much, Dr. Gibbons. It is a pleasure.

April 22, 1994

RESPONSE TO QUESTIONS
SUBCOMMITTEE ON VA, HUD, AND INDEPENDENT AGENCIES
COMMITTEE ON APPROPRIATIONS
U.S. HOUSE OF REPRESENTATIVES

QUESTION: **Please clarify the nature of the pause on indirect costs.**

ANSWER: For FY 1995, the Administration proposes to instruct university and nonprofit grantees not to seek additional payments for overhead above amounts claimed in FY 1994. This provision will apply only to those institutions which reported outlays in excess of $10 million in FY 1994, and will not affect institutions which did not receive funds prior to FY 1995, or those claiming overhead payments below their FY 1994 level. The savings the Administration expects to achieve will amount to less than 1 percent of total federal support to the university and non-profit research enterprise, and less than 5 percent of the amount now claimed for overhead costs in these institutions.

Most academic research grants are issued by six agencies: HHS (54%); NSF (15%); DOD (12%); NASA (6%); DOE (5%); and Agriculture (4%). We expect savings attributable to an agency will accrue at levels commensurate with spending.

This one year pause will provide time for the Council of Economic Advisers, the Office of Science and Technology Policy, and the Office of Management and Budget, with advice from affected institutions, to conduct a comprehensive review with the purpose of improving the incentives that govern overhead payments for a wide range of Federal grantees and contractors.

QUESTION: **How much of the "pause" savings come from NSF?**

ANSWER: It is estimated that approximately $27 million of the total $150 million savings derived from the "pause" would be realized through NSF-supported research conducted by universities and non-profit institutions.

QUESTION: **Does the pause apply to contracts as well as grants?**

ANSWER: Language in the Administration's budget proposal calls for the pause to be applied to university and non-profit research grantees. However, it is anticipated that the one-year review of the incentives to reduce overhead costs will include examination of a wide range of Federal grantees and contractors

QUESTION: What is OSTP doing to increase the number and grade of African-Americans specifically? I am interested in Hispanics as well.

ANSWER: As you know, OSTP spent a significant portion of last year recruiting candidates for subcabinet positions requiring scientific or technical expertise. You can now see, in the senior science and technology policy positions of the Federal Government, the many faces of this great nation, an accomplishment that will greatly enhance the ability to develop and implement effective programs for the benefit of all our people. In the course of recruiting for subcabinet positions and scientific and technical advisory committees, we have vastly expanded our links to historically black universities and emerging centers of Hispanic scientific expertise. Some of the individuals recruited, for instance Dr. Johnetta Cole, President of Spelman College, have specifically agreed to help OSTP locate minority candidates for our senior science and technology policy positions. We also now have an important connection with the University of Texas at El Paso, which has more Hispanic engineers and minority technical graduates than any other American university. In addition, we are receiving employee candidates from the Society for Advancement of Chicanos and Native Americans in Science. With our growing network, we expect much greater success in recruiting minority employees for senior OSTP positions.

QUESTION: What is the status of U.S. participation in UNESCO

ANSWER: The United Nations Educational, Scientific, and Cultural Organization (UNESCO) has 180 countries as members. The U.S. withdrew from UNESCO in December 1984 due to excessive politicization and poor management of the organization. Since the election of Spanish biochemist Federico Mayor as Director General in 1987, and subsequent reelection in 1993, UNESCO has made significant progress in solving these problems. GAO conducted a study in June 1992, with a follow-up report in March 1993, and concluded that UNESCO had reformed its management.

An interagency working group met in June 1993 and concluded that the U.S. should reenter UNESCO provided that funds could be found. A final decision on this question will soon be made.

The U.S. scientific community maintains significant professional contact with UNESCO science programs via the non-governmental International Council of Scientific Unions, a partnership which Director General Mayor has promoted.

April 22, 1994

RESPONSES TO WRITTEN QUESTIONS SUBMITTED BY REPRESENTATIVE DELAY

Question 1: Considering the commitment the President has made to building the space station, how do you intend to convey the message to Congress that science programs are in fact not being "eaten alive" by the space station?

The Administration initiated the space station redesign to reduce costs and restructure the program to maintain a balanced program within NASA. Under the previous Space Station Freedom program annual expenditures were estimated at approximately $3 billion; the restructured program's annual budget is significantly less at $2.1 billion over the next 5 years. This step alone has reduced what would have been an undue stress on the overall budget of the agency, including science programs. The Administration will continue to support a strong space science program within the context of our overall goal of reinventing NASA. Because the current budget environment is so constrained, it is more important than ever for NASA to focus on smaller, less costly, more frequent science missions. We are encouraged by the direction Administrator Goldin has taken in this respect and will continue to support innovative approaches to accomplishing good science at less cost. It is also important to note that the Space Station will itself serve as a unique platform and on-orbit research facility for critical life sciences and microgravity research, two areas of interest to the scientific community. I will continue to advise the President to support the program we have proposed that retains a realistic balance between space science, human space flight, aeronautics and Mission to Planet Earth.

Question 2: How important does this Administration feel the VA/HUD budget allocation is in terms of its support for space station? If the overall NASA budget is cut beyond what some Members have said is necessary for their support for station, what will the Administration's message be to those Members?

The Administration is aware of the difficult choices that the Congress faces in the 602(b) allocation process and welcomes the opportunity to highlight the importance of the space station program in this context. We urge the Congress in the strongest terms to fully allocate funds to meet the President's budget for the VA/HUD subcommittee. This subcommittee will be a key element in advancing many of the Administration initiatives. In this context, the Administration places a high priority on fully funding the NASA budget. The space station program is an initiative that we cannot afford to cut. We intend to clearly convey this message to Members as a priority program for the President.

Question 3: How many people are responsible for handling space issues in OSTP? How are you planning to allocate responsibilities so that space issues have sufficient focus? How does this configuration compare to the focus provided under the Space Council? How do you plan to marshall your resources to ensure that funding for space station passes the House this year?

ANSWER: In November of last year, President Clinton established a single Cabinet-level policy council -- the National Science and Technology Council (NSTC) -- to merge the responsibilities of a number of previously-existing science and technology policy mechanisms, including the National Space Council. President Clinton's decision to create a National Science and Technology Council reflects his commitment to strengthen the science and technology policy structure within the White House as well as his desire to see all of science and technology given a much more prominent place in this Administration. The NSTC was established to elevate the role of all science and technology policy in decision making, including space policy.

As Assistant to the President for Science and Technology, it is my responsibility to support and direct the operations of the NSTC, and coordination of space policy through the NSTC is a high priority for my office. On a day to day basis, there are at least 10 people within OSTP who are involved in substantial space technology or program- related activities. Each of the Associate Directors in Technology, Science, National Security and International, and Environment brings their own unique contribution to the maintenance and oversight of the civilian and military aeronautics and space programs, with the Associate Director for Technology carrying the lead responsibility for NASA. In addition to the Associate Directors and their division staffs, there is also an Assistant Director for aeronautics and space who works to coordinate aeronautics and space activities among the four divisions and to ensure that there is adequate information flow and coordination among the other relevant White House entities such as OMB, NEC, and the NSC.

Within the area of space policy, the international space station is a high priority for the Administration. Throughout the past 15 months, OSTP has coordinated the White House review of the space station redesign effort, and OSTP will continue to coordinate Administration efforts to gain Congressional support for the redesigned international space station. Currently, that effort includes the Office of the Vice President, the National Security Council, the National Economic Council, the Office of Management and Budget, and a number of Federal departments and agencies. I look forward to working with the Committee to support this very important initiative.

Question 4: Why are you so resistant to supporting [SSTO] this type of technology? Have any decisions been made by the Administration in terms of releasing this funding?

The Administration is not opposed to SSTO technologies. OSTP is currently heading an interagency review of space transportation policy which will prepare a national strategy for space transportation. As part of this strategy, we expect to address the question of advanced technologies, such as single-stage-to-orbit. This is an interesting technology that could reduce launch costs, although initial development costs could be high. A level of investment that will enable us to verify the appropriate technologies and demonstrate this concept is being considered as part of our policy review. It is important, in my view, that we have all the facts at our disposal--particularly those regarding technical risk and cost--before any decision is made to proceed with a new vehicle development. In the current constrained funding environment, this is the most prudent course. It does not mean we are opposed to SSTO technologies. We support an approach which will verify the SSTO technologies which we will need in order to make an informed decision.

Question 5: Have you reviewed the NASA "Access to Space" report? What does the Administration think of NASA's recommendation?

The NASA "Access to Space" report is being considered within the context of OSTP's space transportation review. Again, we believe there are a number of technology and cost issues that need to be addressed before a commitment to a new vehicle development and retirement of the existing Shuttle and ELVs could be made. Until we have fully addressed those issues, it is premature to adopt any one particular SSTO concept (i.e., vertical take and landing vs. vertical take off and horizontal landing). We believe the NASA report has provides a useful starting point for continued discussion on SSTO options.

I. GENERAL STATEMENT

Executive Office of the President
Office of Science and Technology Policy

The National Science and Technology Policy, Organization, and Priorities Act of 1976 (Public Law 94-282) mandates that OSTP shall:

- Advise the President and others within the Executive Office of the President on the impacts of science and technology on domestic and international affairs;
- Evaluate the scale, quality, and effectiveness of the Federal effort in science and technology;
- Lead an interagency effort to develop and implement sound science and technology policies and budgets;
- Work with the private sector to ensure Federal investments in science and technology contribute to economic prosperity, environmental quality, and national security;
- Build strong partnerships among Federal, State, and local governments and the scientific community.

OSTP's Senate-confirmed Director also serves as Assistant to the President for Science and Technology Policy. In this role, he supports the President's National Science and Technology Council (NSTC), which has responsibility for:

- coordinating the science and technology policy making process;
- ensuring science and technology policy decisions and programs are consistent with the President's stated goals;
- helping to implement and integrate the President's science and technology policy agenda across the Federal government;
- ensuring science and technology are considered in development and implementation of all Federal policies and programs; and
- furthering international cooperation in science and technology.

The NSTC is the President's mechanism for directing Federal R&D activities and for developing a strategy for science and technology investments by the Federal government that integrates agency missions with national goals. OSTP staff help fulfill these responsibilities by forming interagency teams that combine the talents of the Federal departments and agencies responsible for science and technology policies and programs. These teams work closely with the private sector to develop program goals and implementation plans.

A Senate-confirmed Associate Director leads each of OSTP's four divisions:

Technology Division

The Technology Division leads the White House effort to develop and implement federal policies for technology that foster its contributions to national goals such as economic prosperity, environmental quality, and national security. Priorities include: redirecting the U.S. space and aeronautics program, including the space station; sustaining U.S. leadership in defense technology while increasing the focus on dual use and civilian technologies; improving education and training in formal school settings and on the job; facilitating development and dissemination of advanced manufacturing technologies; and accelerating development and adoption of advanced computational and communications technologies.

Science Division

The Science Division leads the White House effort to ensure: 1) the U.S. continues to maintain global leadership in the physical, life, and social sciences; and (2) science continues to provide support for successful resolution of a number of our most important problems in the areas of health, agriculture, the economy, energy, social well-being, education, and national security. The Division will focus on the broad, generic questions of science and on "cutting edge" research that transcends traditional scientific boundaries.

Environment Division

The Environment Division leads the White House effort to develop a sound, scientific and technical underpinning for environmental policies and to integrate environmental, energy, and economic policies. Issues addressed include global climate change, ozone depletion, loss of biological diversity, desertification, deforestation, pesticides and toxic substances, urban and regional air quality, water quality, hazardous and solid waste, and marine pollution. The Division also has responsibility for promoting risk analysis and environmental education programs.

National Security and International Affairs Division

The National Security and International Affairs Division leads the White House effort to bring scientific and technological realities and opportunities to bear on national security policy and to shape and coordinate policies for international cooperation in science and technology. The national security agenda includes focus on: technical aspects of arms control, disarmament, and nonproliferation policy; technology transfer and related export control policies; defense and intelligence technology; and science and technology to promote political and economic reform in the former Soviet Union. The international agenda includes: 1) using U.S. leadership in S&T to support foreign policy objectives; 2) strengthening American S&T in the context of an increasingly interdependent world; 3) using international cooperation in S&T to support domestic economic and competitiveness agendas; 4) coordinating the international aspects of R&D funding; and 5) negotiating and implementing bilateral science and technology agreements and organizing U.S. participation in the Organization for Economic Cooperation megascience forum and in bilateral S&T commissions.

II. SUMMARY OF REQUEST

OSTP requests $5 million for FY 1995. The requested amount would allow OSTP to fulfill its responsibilities in a White House commited to an increased role for science and technology in national and international affairs. It also accommodates an increased workload resulting from the White House decision to merge the staff functions of the National Space Council and the National Critical Materials Council into OSTP.

The requested FY 1995 budget will support the Director and four Associate Directors plus a staff of 35 seasoned professionals with diverse training and experience. This configuration is essential given the number of issues addressed by OSTP and the need for flexible response to emerging priorities. OSTP will also utilize up to 6 detailees from other agencies to fulfill staffing needs in very specialized science and technology areas.

Increased personnel compensation costs make the greatest demand on OSTP's budget. We are tightening our belts--e.g., we delayed filling certain positions and limited consultant work hours in order to absorb the 4.23% locality pay increase in FY 1994--but further cuts in this area will severely diminish our effectiveness. In addition, OSTP has complied with the requirement to reduce administrative expenses.

OSTP has a critical role to play in coordinating science and technology policy for the Executive Branch. The budget requested for Fiscal Year 1995 would enable OSTP to support the President's objectives for science and technology by making it possible to attract and retain a permanent staff with the breadth of experience and expertise to do the job.

Executive Office of the President
Office of Science and Technology Policy

BUDGET OVERVIEW

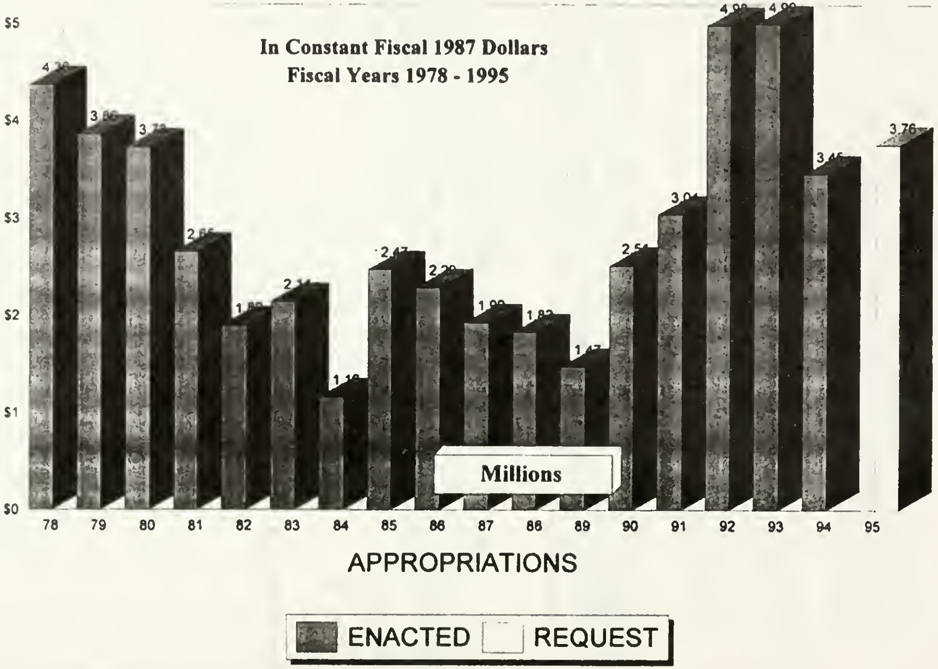
(in thousands of dollars)

	Enacted FY 1993	Enacted FY 1994	Request FY 1995	Net Change FY 94-95
Budget Authority:				
Appropriation	$6,225	$4,450	$5,000	+$550
FTE Employment:				
FTP	43	40	40	0
Other than FTP	0	0	0	0
Total FTE	43	40	40	0
Detailee Employment	11	6	6	0

Executive Office of the President

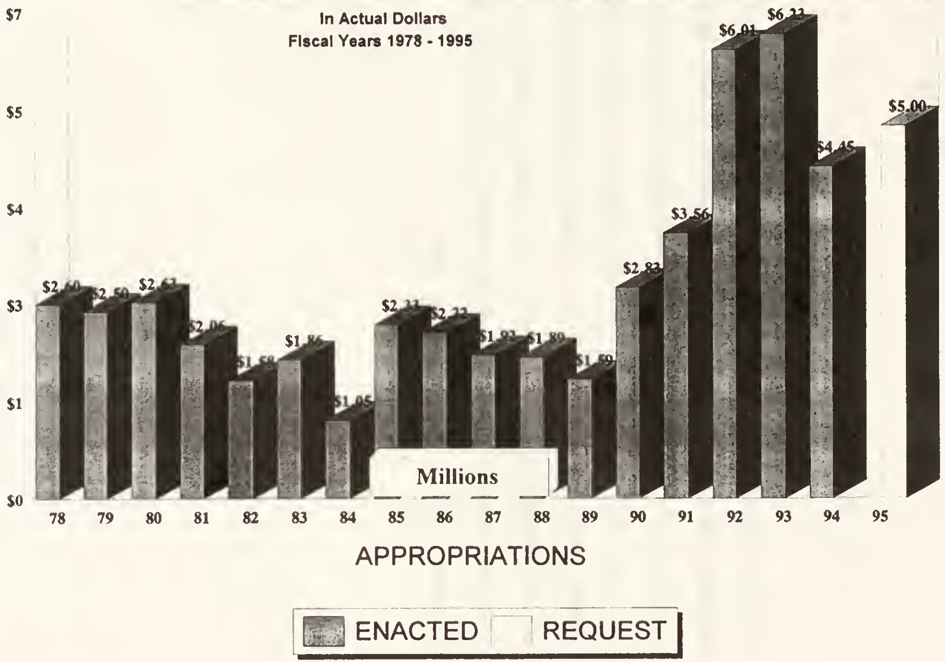
Office of Science and Technology Policy

HISTORICAL SUMMARY OF APPROPRIATIONS



Executive Office of The President
Office of Science & Technology Policy

HISTORICAL SUMMARY OF APPROPRIATIONS



III. APPROPRIATION LANGUAGE

Executive Office of the President
Office of Science and Technology Policy

Salaries and Expenses

For necessary expenses of the Office of Science and Technology Policy, in carrying out the purposes of the National Science and Technology Policy, Organization, and Priorities Act of 1976 (42 U.S.C. 6601 and 6671), hire of passenger motor vehicles, services as authorized by 5 U.S.C. 3109, not to exceed $2,500 for official reception and representation expenses, and rental of conference rooms in the District of Columbia [$4,450,000] $5,000,000: Provided, That the Office of Science and Technology Policy shall reimburse other agencies for not less than one-half of the personnel compensation costs of individuals detailed to it. (Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations Act, 1994.)

Executive Office of the President
Office of Science and Technology Policy

Program and Performance

The Office of Science and Technology Policy (OSTP) provides advice and recommendations to the President concerning policies in science and technology and on the utilization of science and technology in addressing important national problems. The OSTP operations include support to other Executive Office of the President organizations on issues with science and technology considerations; review and analysis, with the Office of Management and Budget, of research and development budgets for all Federal agencies; coordination of research and development programs of the Federal Government; coordination of the implementation of a number of important international science and technology agreements; and other activities necessary to carry out the duties, functions, and activities described in Public Law 94-282, the National Science and Technology Policy, Organization, and Priorities Act of 1976.

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STANDARD FORM 300
July 1964, Bureau of the Budget
Circular No. A-11, Revised.
300-101

Office of Science and Technology Policy
Salaries and Expenses
Object Classification (in thousands of dollars)

Identification code 11-2600-0-1-802	19 93 actual	19 94 estimate	19 95 estimate
Direct obligations:			
Personnel compensation:			
11.1 Full-time permanent	1,363	2,218	2,510
11.3 Other than full-time permanent	365	88	150
11.5 Other personnel compensation	73	40	98
11.8 Special personnel services payments	650	401	415
11.9 Total personnel compensation	2,451	2,747	3,173
12.1 Personnel benefits: Civilian	365	539	581
Total Personnel Compensation and Benefits	2,816	3,286	3,754
Non-Personnel Expenses:			
21.0 Travel and transportation of persons	106	180	250
22.0 Transportation of things	5	5	5
23.1 Rental payments to GSA	430	485	497
23.3 Communications, utilities, and miscellaneous charges	248	185	185
24.0 Printing and reproduction	62	65	55
25.1 Consulting services	66	50	40
25.2 Other services	99	64	64
26.0 Supplies and materials	49	70	70
31.0 Equipment	203	60	80
Total Non-Personnel	1,268	1,164	1,246
99.0 Subtotal, direct obligations	4,084	4,450	5,000
99.0 Reimbursable obligations	39	25	25
99.9 Total Obligations	4,123	4,475	5,025
(Memo cast: 31.5)	(Memo cast: 8)	(Memo cast: 5)	(Memo cast: 6.0)

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Circular No. A-11, Revised.
300-103

Office of Science and Technology Policy
Salaries and Expenses

DETAIL OF PERMANENT POSITIONS

11-2600-0-1-802	19 93 actual	19 94 estimate	19 95 estimate
Executive Level II	1	1	1
Executive Level III	1	4	4
Subtotal	2	5	5
ES-4	0	0	0
ES-3	3	4	4
Subtotal	3	4	4
GS-15	6	11	12
GS-14	1	0	0
GS-13	0	1	1
GS-12	3	2	3
GS-11	0	1	3
GS-10	2	3	5
GS- 9	4	7	4
GS- 8	4	3	1
GS- 7	1	0	0
GS- 6	0	0	1
GS- 5	0	1	0
GS- 4	1	0	0
Subtotal	22	29	30
TOTAL PERMANENT	27	38	39
(Mono cast: 16.3)	(Mono cast: 4.9)	(Mono cast: 4.9)	(Mono cast: 4

GPO : 1976—241-530/2037

IV. EXPLANATION AND JUSTIFICATION OF CHANGES BY OBJECT CLASS FOR FY 1995

Executive Office of the President
Office of Science and Technology Policy
(in thousands of dollars)

Total Increase Requested	$550

Within OSTP's operational budget, the larger components of the increase are:

- Hiring up to fully authorized 40 FTE positions and 6 Detailees
- Assumed a 1.6% General Pay Raise in January 1995
- Travel in support of a reestablished Presidential science and technology advisory committee

PERSONNEL COMPENSATION

FY '94	FY '95		
$3,286	$3,754	Personnel Compensation	$468

This category includes funding to support 40 full-time equivalent (FTE) personnel for OSTP and 6 detailees.

The requested increase of $468,000 would enable OSTP to fill positions previously left vacant because of budgetary constraints and scheduled pay increases (grade/step increases). OSTP staff must be highly-seasoned professionals in scientific and technical fields, which requires salaries sufficient to attract needed expertise.

A general pay raise in the amount of 1.6% was assumed for January 1995. The pay raise makes no assumption as to how it will be distributed between possible locality and ECI-based increases.

NON-PERSONNEL EXPENSES

FY '94	FY '95		
$ 180	$ 250	Travel and transportation of persons	$70

This category supports the following:

(1) Domestic travel associated with OSTP's role in Presidential science and technology initiatives. The Administration's commitment to timely, frequent interaction with the private sector in developing and implementing policies and programs necessitates substantial domestic travel.

FY '94 FY'95

(2) International travel is associated with the growing number of bilateral and multilateral agreements entered into with other nations; travel associated with high-level international committee meetings; the Gore/Chernomyrdin S&T Committee; Joint Consultative Meetings; the Organization for Economic Cooperation and Development (OECD) meetings; meetings with United Nations organizations; meetings in support of international assessments such as ozone depletion, climate change, and biodiversity; global environmental issues and research programs; etc.

(3) Travel in support of a Presidential science and technology advisory committee. OSTP has budgeted for meetings of the full committee as well as meetings of panel groups to address specific topics.

FY '94	FY'95		
$ 5	$ 5	Transportation of things	$ 0

This category supports shipping and Federal Express expenses. This request is unchanged from FY94.

FY '94	FY'95		
$ 485	$ 497	Rental payments to GSA	$12

An increase of $12,000 is anticipated for FY 1995 rental payments to GSA. This is the result of the reallocation of space within the EOP during FY 1994.

FY '94	FY'95		
$ 185	$ 185	Communications, utilities, and miscellaneous charges	$ 0

This category provides funds for commercial utilities including telephone services (AT&T, FTS); GSA utilities; postage; rental of outside conference rooms; pagers and data links. No increase is anticipated during FY 1995.

FY '94	FY'95		
$ 65	$ 55	Printing and reproduction	($10)

These funds provide for government and commercial printing requirements, including reports to the Congress and announcements in the Federal Register. The decrease of $10,000 is anticipated. OSTP plans on printing new OSTP, Presidential advisory committee and NSTC brochures during FY 1994. Such an effort would not be required in FY 1995. The funds requested are in support of other regular reports OSTP expects to generate in FY 1995.

FY '94	FY '95		
$ 50	$ 40	Consulting Services Contracting dollars are for specialized deliverables to fill short-term, highly specialized information needs.	($10)
$ 64	$ 64	Other services This category includes the costs associated with building alterations, equipment repair, including maintenance contracts, training, health services, EOP Office of Administration services, and representational fund expenses.	$ 0
$ 70	$ 70	Supplies and materials This category includes costs for office supplies, computer supplies (including off-the-shelf software), and newspaper/periodical subscriptions. No increase is requested in FY 1995.	$ 0
$ 60	$ 80	Equipment This category includes equipment (e.g., computers, telefax machines, copiers, dictating equipment, etc.); furniture and fixtures; books; and tools (e.g., for in-house repair of computers). The increase of $20,000 is requested in order to purchase modular furniture for the new offices OSTP acquired in FY 1994.	$20

SUMMARY

FY '94	FY '95	
$4,450	$5,000	$ 550

Executive Office of the President
Office of Science and Technology Policy

SUMMARY OF CHANGES FROM FY 1994 TO FY 1995 BY OBJECT CLASS

(in Thousands of Dollars)

	Increases	Decreases	
FY 1994 BUDGET			$4,450
CURRENT PROPOSED FY 1995			$5,000
Personnel compensation	$426	0	
Personnel benefits	42	0	
Subtotal, compensation and benefits	$468	0	
Travel and transportation of persons	70	0	
Transportation of things	0	0	
Rental payments to GSA	12	0	
Comm., util., and misc. charges	0	0	
Printing and reproduction	0	10	
Consulting services	0	10	
Other services	0	0	
Supplies and materials	0	0	
Equipment	20	0	
Subtotal, direct obligations	102	20	
TOTAL	570	20	
Net Increase/Decrease	550	0	

Executive Office of the President
Office of Science and Technology Policy

SUMMARY OF BUDGET AUTHORITY BY OBJECT CLASS

FY 1993-1995

	BUDGET OVERVIEW (in thousands of dollars)			
	FY 1993	Estimated FY 1994	Estimated FY 1995	Net Change FY 94-95
Personnel compensation:				
Full-time permanent	1,363	2,218	2,510	292
Other than full-time permanent	365	88	150	62
Other personnel compensation	73	40	98	58
Special personal services payments	650	401	415	14
Total personnel compensation	2,451	2,747	3,173	426
Personnel benefits: Civilian	365	539	581	42
Total compensation and benefits	2,816	3,286	3,754	468
Travel and transportation of persons	106	180	250	70
Transportation of things	5	5	5	0
Rental payment to GSA	430	485	497	12
Comm., util., and misc., chgs.	248	185	185	0
Printing and reproduction	62	65	55	(10)
Consulting services	66	50	40	(10)
Other services	99	64	64	0
Supplies and materials	49	70	70	0
Equipment	203	60	80	20
Subtotal, direct obligations	1,268	1,164	1,246	82
Subtotal, all obligations	4,084	4,450	5,000	550
Reimbursable obligations	39	25	25	
Total all obligations	4,123	4,475	5,025	550

SUMMARY OF ACCOMPLISHMENTS IN FY 1993
Office of Science and Technology Policy
National Science and Technology Council
President's Committee on Advisors on Science and Technology

The Clinton Administration treats science and technology as high-leverage investments in America's future. Investments in S&T contribute to: a growing economy with more high-skill, high-wage jobs for American workers; a cleaner environment where energy efficiency, information technology, and advanced chemistry increase profits and reduces pollution; a stronger, more competitive private sector able to maintain U.S. leadership in critical world markets; an educational system where every student is challenged; and an inspired scientific and technological research community focused on ensuring not only our national security but quality of life for ourselves and our children. The most important measure of success will be our ability to make a difference in the lives of the American people, to harness science and technology to improve the quality of life and the economic strength of our nation.

The Office of Science and Technology Policy (OSTP) supports these objectives by: providing authoritative scientific and technological information, analysis, advice, and recommendations for the President, for the Executive Branch, and for Congress; participating in the formulation, coordination, and implementation of national and international policies and programs that involve science and technology; maintaining and promoting the health and vitality of the U.S. science and technology infrastructure; and coordinating research and development efforts of the Federal government to maximize the return on the public's investment in science and technology and to ensure that resources are used efficiently and appropriately.

The Director of OSTP also serves as Assistant to the President for Science and Technology and, in that capacity, supports the activities of the President's National Science and Technology Council (NSTC), created November 23, 1993, by Executive Order. The NSTC has responsibility for:

- coordinating the science and technology policy making process;
- ensuring science and technology policy decisions and programs are consistent with the President's stated goals;
- helping to implement and integrate the President's science and technology policy agenda across the Federal government;
- ensuring science and technology are considered in development and implementation of all Federal policies and programs; and
- furthering international cooperation in science and technology.

OSTP also supports the President's Committee of Advisors on Science and Technology, which advises the President and the NSTC. The following pages summarize the activities of these organizations during Fiscal Year 1993.

Accomplishments of the Office of Science and Technology Policy

During FY 1993, OSTP reorganized to incorporate President Clinton's mandate to: 1) redirect the Federal effort in science and technology toward national goals; and 2) streamline White House operations. OSTP, still functioning at its FY 1992 staffing level, now fulfills its statutory responsibilities as well as the staff responsibilities of the National Space Council and the National Critical Materials Council. OSTP's new structure reflects this Administration's science and technology priorities.

A Senate-confirmed Associate Director heads each of OSTP's four divisions. The **Technology Division** also includes an Assistant Director for Technology and provides the administrative base for an Assistant Director for Aeronautics and Space who calls on the resources of each Division to fulfill his responsibilities. The **Science Division** includes an Assistant Director for Health and Life Sciences, an Assistant Director for Physical Sciences and Engineering, and an Assistant Director for Social and Behavioral Sciences. The **Environment Division** has an Assistant Director for Environment, and the **National Security and International Affairs Division** has an Assistant Director for International Affairs and an Assistant Director for Science and Security. Each division has a small, multidisciplinary staff, and cross-cutting issues are managed in matrix fashion.

OSTP's Director testified before Congress over twice a month in 1993, including the following statements:

" Technology for America's Economic Growth: A New Direction to Build Economic Strength," before the House Committee on Science, Space, and Technology

" Renewable Energy Resources," before the Senate Subcommittee on Toxic Substances, Research and Development; Committee on Environment and Public Works

" Global Change," before the Senate Committee on Energy and Natural Resources

" Information Infrastructure and the High Performance Computing and High Speed Networking Applications Act of 1993," before the House Committee on Science, Space, and Technology

" The Administration's Technology Policy and Small Business," before the House Committee on Small Business

" The Technology and Industrial Base Needed for National Security," before the Subcommittee on Defense Technology, Acquisition, and Industrial Base of the Senate Committee on Armed Services

" New Environmental Technologies," before the Senate Committee on Environment and Public Works

" Space Station Redesign," before the Subcommittee on Veterans' Administration, HUD, and Independent Agencies of the House Committee on Appropriations

" Administration's Technology Initiatives," before the Joint Economic Committee

" Environmental Technology," before the Subcommittee on Technology, Environment, and Aviation of the House Committee on Science, Space, and Technology

"The Superconducting Supercollider," before the Senate Committee on Energy and Natural Resources

"The Gore-Chernomyrdin Agreements," before the Subcommittee on Space Science and Applications, House committee on Science, Space, and Technology

The Associate Director for Technology also testified, on dual use technologies, before the Subcommittee on Science, House Committee on Science, Space, and Technology.

The Director and staff also played key roles in screening, recruiting, and interviewing candidates for subcabinet posts in Departments and Agencies with responsibilities for science and technology programs.

During its first months in action, the "new" OSTP led White House efforts on several issues of critical national and international concern, including:

Implementing the Technology Initiatives

OSTP, working closely with the National Economic Council, produced, for the President and the Vice President, one of the seminal documents of the Clinton Administration: Technology for America's Economic Growth: A New Direction to Build Economic Strength. This document heralds a new era of cooperation between the public and private sectors in achieving national goals and clearly evinces our intention to use the Federal investment in science and technology to further those goals. We have established interagency efforts to address issues of major concern, such as: defense reinvestment and conversion; patient capital and technology financing; Federal support for manufacturing research;

technology for education and training; government infrastructure; space and aeronautics; partnerships between the National Laboratories and industry; and basic sciences.

One early success story in the technology plan is the Information Infrastructure Task Force (IITF), which is charged with forging the Administration's policy on telecommunications and information. The task force developed an integrated federal policy framework to support a plan for a national information infrastructure. This plan will promote private research and investment in a system capable of vastly improving the way information is communicated, stored, and processed in the United States. In 1993, the plan led to improvements in: 1) management of the radio frequency spectrum; 2) the framework for protecting intellectual property; 3) access to government information; and 4) coordination of Federal, State, and local regulatory activities.

OSTP, working closely with the Department of Commerce and other agencies, has spearheaded an effort to establish a new cooperative relationship with the automobile industry. Specifically, a major initiative was undertaken early in the Administration's tenure to develop an understanding with car manufacturers and related businesses that would enable joint pursuit of long-term research and development programs leading to a "clean car" -- one that would provide the amenities we enjoy, such as comfort, safety, and performance, and produce little or no pollution. In September 1993, the President signed an agreement with the CEO's of the Big 3 automakers to jointly pursue a research agenda for a car 3-times as fuel efficient as today's that can help eliminate pollution and dependence on foreign oil imports while capturing markets for environmentally sound technologies here and abroad.

Defense Conversion

OSTP participated in reorganization of the Advanced Research Projects Agency at the Department of Defense and helped launch the Technology Reinvestment Project (TRP) to stimulate the public and private sector transition from defense to dual use technologies that have both military and civilian applications. The TRP is an integrated effort by 6 government agencies. The Federal Government received TRP proposals from teams representing more than 12,000 companies, universities and local governments. Significantly, proposals totaling over $8.5 billion in matching private funds were received in competition for a relatively modest federal investment of $470 million.

Redesigning the Space Station

Almost immediately upon assuming office, the Administration had to determine the merits of continuing the space station program. OSTP was instrumental in the decisionmaking process leading to the decision to redesign, rather than discontinue, the program, and to reconfigure NASA for more effective and efficient management and operations.

OSTP was the focal point for White House engagement in all phases of the redesign effort. Coordinating closely with the National Security Council, the National Economic Council, the Office of Management and Budget, and the Office of the Vice President, OSTP provided NASA with the broad policy guidance necessary to carry out the internal redesign effort, to incorporate the findings of the independent, blue-ribbon Vest Commission in its final redesign decisions, and, now, to implement those decisions with our international partners.

Integrating Science and Technology with Environmental Policy

OSTP has made significant scientific and technical inputs to a number of key environmental actions. These include the President's Earth Day speech on the stabilization of greenhouse gas emissions; the development of the U.S. National Action Plan for greenhouse gas emissions; and the Northwest forest action plan. In addition, OSTP is playing a leadership role in the development of the 1994 World Meteorological Organization/United Nations Environment Program (WMO/UNEP) international ozone assessment, the 1994 WMO/UNEP Intergovernmental Panel on Climate Change (IPCC) assessments, and the 1994 UNEP Global Biodiversity assessment.

OSTP has also established a senior-level interagency committee to provide an integrated science-technology-economics-policy interface. The committee is co-chaired by OSTP, the Office of Environmental Policy, and the Council of Economic Advisors and will function as a bridge between science and policy by developing integrated assessments of key environmental issues.

OSTP is committed to providing the leadership needed to revitalize the space programs essential to global climate change research. OSTP established an interface to NASA's Earth Observing System Data Information System (EOSDIS) and also provided support toward organization of a National Academy of Science panel on EOSDIS and assisted in writing the charge to Academy members and suggested that a Blue Ribbon panel be appointed to emphasize the importance of this issue.

The devastating floods along the Mississippi River and its tributaries generated a major effort by OSTP to insert environmental science and technology into post-flood plans to reclaim the flooded lands and reestablish the flood control systems. OSTP worked closely with OMB, the Office of Environmental Policy, and many Executive Branch agencies to ensure the Federal Government's rapid, compassionate responses did not unnecessarily foreclose any long-term options for wise redevelopment of the damaged areas. An interagency Scientific Assessment and Strategy Team was established to examine the scientific issues associated with short- and long-term flood recovery and to develop criteria for policy and funding priorities.

OSTP worked with other federal agencies to establish the Electric and Magnetic Fields Interagency Committee which was mandated by the Comprehensive National Energy Policy Act of 1992. After review of the legislation OSTP worked with the appropriate agencies to assign representatives. outline the committee program and products. Co-chairs from DOE and NIEHS were subsequently selected to carry out the mandated program as charged.

Enhancing National Security

OSTP has contributed significantly to an examination of policies toward the Former Soviet Union where science and technology play a critical role. It has assessed the technical aspects of dismantlement of nuclear forces and testing of nuclear warheads, reviewed evolving technology transfer policies, assessed nonproliferation goals and strategies, and evaluated the Russian technical brain drain.

The post-Cold War environment has dramatic implications for U.S. intelligence resources. OSTP worked with the intelligence community to redirect resources toward changing requirements, including refocusing economic and S&T analyses and assessing capabilities of collection systems for use in environmental analysis, and to identify unique technologies and capabilities that may have commercial applications.

The Director of OSTP is responsible for managing the nation's telecommunications resources during wartime crises and non-wartime emergencies. OSTP works closely with the National Security Council, OMB, and the National Communications Systems to improve the readiness and effectiveness of the Federal Government response to telecommunications crises.

Military space operations are being shaped by the end of the Cold War and by the need for a closer relationship between defense, civil, and commercial space activities. OSTP is leading White House efforts to define national policy on space launch and excess ballistic missiles and continues to coordinate joint Department of Defense (DOD) and civil aerospace programs.

OSTP assists DOD in reorienting missile defense programs to address post-Cold War dangers. Policies are being implemented with the Ballistic Missile Defense Organization to technically prepare for third world ballistic missile threats.

OSTP established an interagency working group that prepared a U.S. position on space debris and space nuclear power. This position was accepted by the U.N. Committee on the Peaceful Uses of Outer Space.

Promoting International Cooperation in Science and Technology

OSTP leads the White House effort to coordinate Federal support -- from the Department of State and a cluster of 20 technical agencies -- for international cooperation in science and technology. As part of this effort, OSTP has developed bilateral science and technology agreements. OSTP has actively participated in recent negotiations with Canada, Australia, the European Community and many of its members states, including Germany, France, and Italy. It successfully led the U.S. effort to conclude negotiations with Japan to renew for five years the key U.S.-Japan Science and Technology Agreement. Under OSTP leadership, model annexes on intellectual property rights were developed for S&T agreements, since adequate protection of such rights remain the most visible obstacles to concluding S&T agreements with our major partners.

OSTP led the White House effort to examine the character and magnitude of U.S. - Russian S&T interactions from the perspective of Federal agencies, the private for-profit sector, and academic and professional institutions, and to identify barriers affecting cooperation and propose solutions. It has promoted the use of Nunn-Lugar funds to support a Research and Development Foundation in Russia.

OSTP led successful negotiations for a new Science and Technology Agreement with Russia to promote bilateral S&T cooperation and support Russian reform process. Vice President Gore and Russian Prime Minister Chernomyrdin signed the new US-Russia S&T Agreement during their December meeting in Moscow, providing a new framework for S&T cooperation in the two countries. The agreement defines overall responsibility and procedures under which cooperative S&T activities will be supported, and provides for the full protection of any intellectual property that results from cooperative programs. The final agreement on the treatment of intellectual property represents an important advance in the bilateral relationship between the United States and Russia, and paves the way for cooperative activities not only in the areas of science and technology, but in virtually all fields of cooperation.

During the December meeting with Prime Minister Chernomyrdin, the Vice President proposed a joint study on strategies for shutting down the two remaining Russian military plutonium-production reactors still operating at Tomsk. These two reactors and a third near Krasnoyarsk are still operating -- nominally because they provide heat and electric power to the nearby populations. OSTP is coordinating White House response and providing technical analysis for the study.

In 1993, OSTP led efforts to renew the U.S.-Japan Agreement on Science and Technology. The 1988 U.S.-Japan Agreement on Science and Technology, the primary vehicle for coordinating S&T cooperation between the two countries, was due to expire in June, 1993. The Agreement was formally renewed in June for another five years following a formal meeting of the U.S.-Japan Joint High Level Committee in May, reestablishing close ties between Japan and the U.S. in science and technology. S&T Cooperation with China was also reestablished in 1993. OSTP agreed to host the first meeting in five years of the Joint Committee under the U.S.-PRC Agreement on Science and Technology, tentatively scheduled to be held in mid-April 1994.

OSTP led U.S. efforts to promote international collaboration in large science programs through the OECD Megascience Forum. The OECD Megascience Forum in 1993 addressed issues in international collaboration, including means of improving coordination among nations, in the areas of astronomy, oceanic and continental deep drilling, global change research and oceanography. The U.S. hosted the experts meeting on global change research, and was a leader in discussions on deep drilling and oceanography. OSTP led the U.S. delegation to each of the Forum meetings.

Also within the OECD, OSTP led U.S. efforts in drafting a report by the Group of National Experts on Biotechnology Safety (GNE) on biofertilizers, plants, and food safety. GNE activities are the primary forum for international harmonization of biotechnology regulations. In the area of trade, OSTP has provided significant input to policy discussions concerning R&D subsidies and GATT negotiations.

OSTP implemented a review of U.S. Policy Toward Fusion Energy and the International Thermonuclear Experimental Reactor (ITER). The review included examination of the status of fusion technology, the site selection process for ITER, and the economic viability of fusion energy. This effort initiated the process of developing a recommendation for the President on the future of U.S. support for international fusion energy research programs.

Sustaining World Leadership in the Sciences

OSTP co-sponsored a forum in January 1994 to consider the future of science in the national interest. The purpose of the meeting was to provide background for science policy development and affirmation of the Administration's commitment to science, mathematics, and engineering. This commitment extends to education of a well-trained workforce and of a scientifically literate public. The effort built on the PCAST report "Renewing the Promise: Research-Intensive Universities and the Nation," which concluded that if the U.S. is to maintain its scientific and technological leadership, universities must adapt to the radical changes caused by the end of the Cold War, the emergence of a highly competitive global economy, and limited resources for the foreseeable future. It also incorporated findings of the report, "Trends in the Structure of Federal Science Support," prepared by the working group on the Structure of Science Support of the FCCSET Committee on Physical, Mathematical, and Engineering Science.

During 1993, OSTP worked with the scientific community and the government science agencies on a number of issues of national importance, including the B-factory, support of the Tevatron, the Advanced Nuclear Source, and other physical sciences initiatives. OSTP has also coordinated an interagency approach to merit-based support of research in universities located in states with small per capita federal funding of R&D. This has been predominantly through the Experimental Programs to Stimulate Competitive Research An OSTP report on the issue has been influential in developing this response to the sense of regional inequity that contributes to the problem of earmarking research funds, which has grown from $809 million in fiscal year 1991 to $1.7 billion in fiscal year 1993.

The National Science and Technology Council

On November 23, 1993, the President signed Executive Order 12881 establishing the National Science and Technology Council (NSTC). The President chairs the NSTC, and the membership includes: the Vice President; the Secretaries of Agriculture, Commerce, Defense, Education, Energy, Health and Human Services, the Interior, Labor, State, and Transportation; the Directors of the Office of Management and Budget and of the National Science Foundation; the Administrators of the Environmental Protection Agency and of the National Aeronautics and Space Administration; and several senior White House officials. Other departments and agencies participate in NSTC activities as appropriate, and, of course, the President can request any official's participation in full council meetings as needed. The NSTC merges and expands the responsibilities of the Federal Coordinating Council for Science, Engineering, and Technology, the National Space Council, and the National Critical Materials Council.

The Executive Order calls for all agencies to coordinate science and technology policy through the NSTC. In addition, the NSTC is specifically directed to develop recommendations on research and development budgets that reflect national goals and to provide advice to OMB concerning individual agencies' R&D budget submissions. This latter function has been the top priority during NSTC's first weeks. We have established R&D Coordinating Committees designed to enable us to produce, for the first time in the Federal Government's history, an R&D budget request that fully integrates the missions of the agencies and the overarching science and technology requirements of the Nation. NSTC Committees working on the Fiscal Year 1996 R&D budget request include:

- Health, Safety, and Food R&D
- Fundamental Science Research
- Information and Communication R&D

- Environment and Natural Resources Research
- National Security R&D
- Civilian Industrial Technology R&D
- Education and Training R&D
- Transportation R&D
- International Science, Engineering, and Technology R&D

Each committee operates with a Department Chair (or co-chairs), a White House Co-Chair, and a Department Vice-Chair. In the course of developing budget requests, the Committees will assist the NSTC in establishing priorities for research, in generating criteria for evaluating progress toward national goals for science and technology, and in refining those goals as science and technology evolve. NSTC's role in crafting R&D budgets that capitalize on agency strengths and eliminate waste and duplication in these stringent budget years is critical to the success of this Administration and to continued government support for research.

The NSTC's work on the R&D budget builds on the efforts of the FCCSET, which developed six interagency cross-cutting initiatives for the FY 1994 budget. These initiatives are in the following areas: (1) global change research; (2) high performance computing and communications; (3) science, mathematics, engineering, and technology education; (4) advanced materials and processing; (5) biotechnology research; and (6) advanced manufacturing technology. These FCCSET initiatives are an important part of the President's economic program and are an integral part of the President's overall strategy for science and technology.

In addition to coordinating the six R&D Initiatives, FCCSET published a number of reports in FY 1993, including:

An Overview of Federal Food Safety Research, Including Emerging Research Needs for the Future - A report of the Working Group on Food Safety Research of the Committee on Food, Agriculture and Forestry Research (January 1993). This report is the culmination of an intensive, two-year examination of the roles and activities of Federal agencies conducting, funding, or overseeing food safety research.

Federal Research Programs in Superconductivity - A report of the Working Group on Superconductivity of the Committee on Industry and Technology (January 1993). This document, the fifth in a series of reports which began in 1988, provides a comprehensive view of the federally-supported research and development in the areas of superconductivity and superconducting materials.

The Human Immunodeficiency Virus Vaccine Challenge: Issues in Development and International Trials - A report of the Working Group on HIV Vaccine Development and

International Field Trials of the Committee on Life Sciences and Health. The report provides a basis for making decisions about: 1) which candidate HIV vaccines to test; and 2) when and where to begin international field trials.

In the National Interest: The Federal Government and Research Intensive Universities - A report by the Ad Hoc Working Group on Research Intensive Universities and the Federal Government (December 1992). The report presents a joint perspective on the relationship between seventeen research-supporting Federal agencies and the Nation's research-intensive universities. The FCCSET report is a companion to the report of the President's Council of Advisors on Science and Technology (PCAST) titled Renewing the Promise: Research-Intensive Universities and the Nation. The FCCSET report makes a series of recommendations that are generally in consonance with those of the PCAST report.

Machine Translation Technology - A report of the Working Group on Machine Translation of the Committee on Industry and Technology (January 1993). This report highlights the major known translation needs and activities of intelligence, defense, and civilian Federal agencies.

National Atmospheric Sciences Program: Fiscal Years 1987-1990 - A report of the Subcommittee on Atmospheric Research of the Committee on Earth and Environmental Sciences (December 1992). This report describes the atmospheric sciences research programs of the agencies that are members of the Subcommittee on Atmospheric Research of the Committee on Earth and Environmental Sciences.

Pathways to Excellence: A Federal Strategy for Science, Mathematics, Engineering and Technology Education, FY 1994-1998 - A report by the Strategic Plan Working Group of the Committee on Education and Human Resources (January 1993). The report presents clearly identified, measurable milestones and objectives in seven program categories, deliverable between 1994 and 1998.

Title V Report - A central reference document that annually reviews illustrative international science and technology themes and provides a database on U.S. international S&T agreements (January 1993).

Trends in the Structure of Federal Science Support - A report by the Working Group on the Structure of Science Support of the Committee on Physical, Mathematical, and Engineering Sciences (December 1992). This report provides a novel profile of trends in research funding by the seven major research and development agencies of the Federal government. Focusing on selected themes such as support for individual investigators, research teams, centers, and research facilities, the descriptions presented provide an instructive complement to traditional program summaries and budget tables.

The President's Committee of Advisors on Science and Technology

Also on November 23, 1993, the President established the President's Committee of Advisors on Science and Technology (PCAST) to:

- advise the President on matters involving science and technology; and
- assist the National Science and Technology Council in securing private sector involvement in its activities.

The direct link to the activities of the NSTC reflects our intention to incorporate advice from the private sector in developing the science and technology budgets and policies of this Administration and our intention to secure private sector advice on the implementation and evaluation of budgets and policies. PCAST will include the Assistant to the President for Science and Technology and luminaries from the private sector representative of the diverse perspectives and expertise in this Nation's investments in science and technology.

The new advisory committee is a successor organization to the PCAST that served President Bush. The members of the former PCAST met with then President Bush in December 1992 to present the following reports:

Achieving the Promise of the Bioscience Revolution: The Role of the Federal Government, Daniel Nathans, Chairman

High Performance Computing and Communications Panel Report, Solomon Buchsbaum, Chairman

Learning to Meet the Science and Technology Challenge, Peter Likins and Charles Drake, Co-chairmen

Megaprojects in the Sciences, John McTague, Chairman

Renewing the Promise: Research-Intensive Universities and the Nation, David Packard, Chairman, and Harold Shapiro, Vice Chairman

Science, Technology, and National Security, Solomon Buchsbaum and John S. Foster, Co-chairmen

Technology and the American Standard of Living, Ralph Gomory, Chairman

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